S-10 ELECTRIC SERVICE MANUAL

1998

GMET/98-ST-3

Book 3 of 3

Includes:
Propulsion
System
and
Shift Controls

CAUTION

In order to reduce the chance of personal injury and/or property damage, carefully observe the instructions that follow:

Service information provided by General Motors Corporation is intended for use by professional, qualified technicians. Attempting repairs or service without the appropriate training, tools, and equipment could cause injury to you or others. This could also damage the vehicle, or cause the vehicle to operate improperly.

Proper vehicle service and repair are important to the safety of the service technician and to the safe, reliable operation of all motor vehicles. If you need to replace a part, use the same part number or an equivalent part. Do not use a replacement part of lesser quality.

The service procedures we recommend and describe in this manual are effective methods of performing service and repair. Some of the procedures require the use of tools that are designed for specific purposes.

Accordingly, any person who intends to use a replacement part, a service procedure, or a tool that is not recommended by General Motors, must first establish that there is no jeopardy to personal safety or the safe operation of the vehicle.

This manual contains *CAUTIONS* that you must observe carefully in order to reduce the risk of injury to yourself or others. This manual also contains *NOTICES* that must be carefully followed in order to avoid improper service that may damage the vehicle, or damage tools or equipment. These *CAUTIONS* and *NOTICES* are not exhaustive. General Motors can not possibly warn of all the potentially hazardous consequences of your failure to follow these instructions.

If the vehicle being serviced is equipped with a Supplemental Inflatable Restraint (SIR), refer to the *CAUTIONS* in the following service manual section/service category type before performing a service on or around SIR Components or wiring:

- Sub-Section 9J - Supplemental Inflatable Restraints, refer to *CAUTIONS* under On-Vehicle Service and the SIR Component Wiring Location view, or,
- Section - Body and Accessories, Sub-Section - Restraints, refer to *CAUTIONS* under On-Vehicle Service and the SIR Component Wiring Location view.

Failure to follow these *CAUTIONS* could cause air bag deployment, personal injury, or otherwise unneeded SIR repairs.

In order to help avoid accidental air bag deployment and personal injury, whenever you service a vehicle that requires repair of the SIR and another vehicle system, we recommend that you first repair the SIR, then go on to the other system.

1998 S-10 Electric Truck Service Manual

Volume 3

This manual provides information on the diagnosis, the service procedures, the adjustments, and the specifications for the 1998 S-10 Electric Truck.

Information on transmission unit repair (overhaul) can be found in the 1998 Transmission/Transaxle/Transfer Case Unit Repair Manual (TURM), GMPT/98-TURM, available separately. The TURM manual contains information on automatic and manual transmissions and transaxles, and transfer cases for all GM passenger cars and light duty trucks, including the fluid flow and circuit description information.

The technicians who understand the material in this manual and in the appropriate Dealer Service Bulletins better service the vehicle owners.

When this manual refers to a brand name, a part number, or a specific tool, you may use an equivalent product in place of the recommended item. All information, illustrations and specifications in this manual are based on the latest product information available at the time of publication approval. General Motors reserves the right to make changes at any time without notice.

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HIGH VOLTAGE SAFETY

CAUTION: DC and AC High Voltage. To help avoid injury, always follow the service manual procedures and manually disconnect the high voltage system before working on or around it.

The S-10 Electric Truck has both high-voltage DC and AC systems, as well as a 12-volt system. DC and AC high-voltage are both very dangerous and can cause severe burns and shock. You first need training about how to repair the S-10 Electric Truck and then must follow the proper repair procedures to minimize the risk.

Currents as low as 0.5 mA AC or 2 mA DC can cause injuries under some conditions. The potential for injury depends on the current path through the body, the amount of current and how long the current flows through the body. Other factors that influence the effect of current are the body's impedance, the frequency of the current, the moisture level of the skin, the size of the contact area, the pressure exerted, temperature, and the physiological characterists of the individual.

AC and DC high-voltage affect the body differently. The varying current with AC high-voltage is more traumatic to the body and can also prevent letting go of the electrodes.

The high-voltage system is independent and isolated from the 12-volt system. When a failure is detected, the high-voltage system is automatically disconnected. There is also a manual disconnect that must be used before service work is performed on or around the high-voltage system.

To help avoid injury:

- Do not work on the S-10 Electric Truck without training. Even the greatest gasoline engine technician needs training for this truck.
- Follow the service manual procedures and cautions.
- ALWAYS assume that high voltage is present.
- To prevent current from having a path through your body, use one hand to do an operation on the high-voltage system.
- Use electrical tape to cover all metal parts of your tools to reduce the chance that the tools will complete a current path.

The battery pack has at least 25 times the energy of one regular automotive battery. Extra precautions are required when the battery pack is removed from the vehicle because the automatic and manual disconnect cannot protect you from a disconnected battery pack. Follow the service manual procedures and cautions.

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REPORTING ERRORS AND SUGGESTIONS

If you find an error in a GM Service manual, or if you have a suggestion about a GM service manual, we want to hear from you.

When calling, be prepared with the following information:

- Your name
- Your dealership's name
- Your dealership's phone number
- The model year and the vehicle line
- The publication part number (if present)
- The vehicle identification number of the vehicle being worked on
- The service manual section and page number(s)
- Any applicable electronic information element identification numbers
- A descriptive explanation of your concern

The GM service manual phone personnel will respond to your concerns in the following ways:

- By delivering your concern to the manual's author.
- By eliciting a response from the author.
- By supplying you with an answer to your concerns.

For paper manual users: The GM service manual phone personnel will also explain how to send in examples or marked-up pages.

For electronic manual users: Be prepared to provide any applicable identification numbers pertaining to the electronic information that you are questioning.

The GM service manual comment telephone numbers do not provide technical assistance. For technical assistance, contact your regular technical assistance source.

United States and Canada General Motors Dealer Employees
Please call the following number Monday through Friday with your comments: 1-800-828-6860, fax number 810-265-9327, 8:00 a.m.-8:00 p.m. Eastern Time Zone.

Canada, French Speaking General Motors Dealer Employees
Please call the following number Monday through Friday with your comments: 1-800-503-3222, fax number 810-265-9327, 8:00 a.m.-6:00 p.m. Eastern Time Zone.

International English Speaking General Motors Dealer Employees
Please call the following number Monday through Friday with your comments: 810-265-0840, fax number 810-265-9327, 8:00 a.m.-6:00 p.m. Eastern Time Zone.

United States and Canadian Vehicle Owner/Operator
Vehicle owners or operators are encouraged to address their comments and concerns to the applicable Customer Assistance Center. The phone number and address of the Customer Assistance Centers are in the Owner's Manual.

STG

GM Service Technology Group

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CAUTIONS AND NOTICES

Definition of Caution, Notice, and Important

Cautions, Notices, and Importants in the Service Manual

The diagnosis and repair procedures in the GM Service Manual contain both general and specific Cautions, Notices, and Importants. GM is dedicated to the presentation of service information that helps the technician to diagnose and repair the systems necessary for the proper operation of the vehicle; however, certain procedures may present a hazard to the technician if they are not followed in the recommended manner. Cautions, Notices, and Importants are elements designed to prevent these hazards; however, not all hazards can be foreseen. This information is placed at strategic locations within the service manual. This information is designed to prevent the following from occurring:

- Serious bodily injury to the technician
- Damage to the vehicle
- Unnecessary vehicle repairs
- Improper repair or replacement of vehicle components. Any caution or notice that appears in General Information is referenced from the individual service categories.

CAUTION Defined

When encountering a CAUTION, you will be asked to take a necessary action or not to take a prohibited action. If a CAUTION is not heeded, the following consequences may occur:

1. Serious bodily injury to the technician.
2. Serious bodily injury to other technicians in the workplace area
3. Serious bodily injury to the driver and/or passenger(s) of the vehicle, if the vehicle has been improperly repaired.

NOTICE Defined

Notices call for special attention to a necessary action or to a prohibited action. If a NOTICE is not heeded, the following consequences may occur:

- Damage to the vehicle
- Unnecessary vehicle repairs
- Unnecessary component replacement
- Improper operation or performance of the system or component under repair
- Damage to any systems or components which are dependent upon the proper operation of the system or component under repair.
- Improper operation or performance of any systems or components which are dependent upon the proper operation or performance of the system or component under repair
- Damage to fasteners, basic tools, or special tools
- The leakage of coolant, lubricant, or other vital fluids.

IMPORTANT Defined

IMPORTANT statements emphasize a necessary characteristic of a diagnostic or repair procedure. IMPORTANT statements are designed to do the following:

- Clarify a procedure
- Present additional information for accomplishing a procedure
- Give insight into the reason or reasons for performing a procedure in the manner recommended
- Present information that will help to accomplish a procedure in a more effective manner
- Present information that gives the technician the benefit of past experience in accomplishing a procedure with greater ease

ABS Handling Caution

CAUTION: Certain components in the Antilock Brake System (ABS) are not intended to be serviced individually. Attempting to remove or disconnect certain system components may result in personal injury and/or improper system operation. Only those component with approved removal and installation procedures should be serviced.

Battery Disconnect Caution

CAUTION: Before servicing any electrical component, the ignition key must be in the OFF or LOCK position and all electrical loads must be OFF, unless instructed otherwise in these procedures. If a tool or equipment could easily come in contact with a live exposed electrical terminal, also disconnect the negative battery cable. Failure to follow these precautions may cause personal injury and/or damage to the vehicle or components.

Brake Dust Caution

CAUTION: Avoid taking the following actions when you service wheel brake parts:

- **Do not grind brake linings**
- **Do not sand brake linings**
- **Do not clean wheel brake parts with a dry brush or with compressed air**

Many earlier model or aftermarket brake parts may contain asbestos fibers which can become airborne in dust. Breathing dust with asbestos fibers may cause serious bodily harm. Use a water-dampened cloth in order to remove any dust on brake parts. Equipment is available commercially in order to perform this washing function. These wet methods prevent fibers from becoming airborne.

Brake Fluid Irritant Caution

CAUTION: Brake fluid may be irritating to the skin or eyes. In case of contact, take the following precautions:

- Eye contact—rinse eyes thoroughly with water.
- Skin contact—wash skin with soap and water.

Electric Coolant Fan Caution

CAUTION: An electric fan under hood can start even when the ignition key is in the OFF position and can injure you. Keep hands, clothing and tools away from any underhood electrical fan.

High-Voltage Caution

CAUTION: DC and AC high-voltage is present. To reduce the risk of severe shocks and burns, the High-Voltage System should be disabled any time service work is being performed on or around the High-Voltage System. When in doubt, always disable the High-Voltage System. The 12-volt system will still be active after the High-Voltage System has been disabled.

Road Test Caution

CAUTION: Road test a vehicle under safe conditions and while obeying all traffic laws. Do not attempt any maneuvers that could jeopardize vehicle control. Failure to adhere to these precautions could lead to serious personal injury.

Safety Goggles and Compressed Air Caution

CAUTION: Wear safety glasses when using compressed air in order to prevent eye injury.

Safety Goggles and Fuel Caution

CAUTION: Always wear safety goggles when working with fuel in order to protect the eyes from fuel splash.

Seat Belt Replacement Caution

CAUTION: Replace belts, retractors, and hardware in use during all but a minor collision. Also, restraint systems should be replaced and anchorage's properly repaired if they were in areas damaged by a collision, whether the belt was in use or not. If there is any question, replace the belt system. Damage, whether visible or not, could result in serious personal injury in the event of an accident.

SIR Caution

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to SIR Component Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

SIR Handling Caution

CAUTION: When you are carrying an undeployed inflator module:

- Do not carry the inflator module by the wires or connector on the inflator module
- Make sure the bag opening points away from you

When you are storing an undeployed inflator module, make sure the bag opening points away from the surface on which the inflator module rests. When you are storing a steering column, do not rest the column with the bag opening facing down and the column vertical. Provide free space for the air bag to expand in case of an accidental deployment. Otherwise, personal injury may result.

SIR Inflator Module Disposal Caution

CAUTION: In order to prevent accidental deployment of the air bag which could cause personal injury, do not dispose of an undeployed inflator module as normal shop waste. The undeployed inflator module contains substances that could cause severe illness or personal injury if the sealed container is damaged during disposal. Use the following deployment procedures to safely dispose of an undeployed inflator module. Failure to dispose of an inflator module as instructed may be a violation of federal, state, province, or local laws.

SIR Special Tool Caution

CAUTION: In order to avoid deploying the air bag when troubleshooting the SIR system, use only the equipment specified in this manual. Failure to use the specified equipment as instructed could cause air bag deployment, personal injury to you or someone else, or unnecessary SIR system repairs.

Vehicle Lifting Caution

CAUTION: To avoid any vehicle damage, serious personal injury or death when components are removed from the vehicle and the vehicle is supported by a hoist, perform the following steps:

- Chain the vehicle to the hoist at the same end as the components that are being removed
- Support for the vehicle at the opposite end from which the components are being removed

Window Removal Caution

CAUTION: When working with any type of glass, use approved safety glasses and gloves to reduce the chance of personal injury.

Window Retention Caution

CAUTION: When replacing stationary windows, Urethane Adhesive Kit GM P/N 12346284, or a urethane adhesive system meeting GM Specification GM3651M, must be used to maintain original installation integrity. Failure to use the urethane adhesive kit will result in poor retention of the window which may allow unrestrained occupants to be ejected from the vehicle resulting in personal injury.

Work Stall Vibration Test Caution

CAUTION: One or more of the following guidelines may apply when performing specific required tests in the work stall:

- When a test requires spinning the drive wheels with the vehicle jacked up, adhere to the following precautions:
  - — Do not exceed 56 km/h (35 mph) when spinning one drive wheel with the other drive wheel stopped. This limit is necessary because the speedometer indicates only one-half the actual vehicle speed under these conditions. Personal injury may result from excessive wheel spinning.
  - — If all of the drive wheels are spinning at the same speed, do not exceed 112 km/h (70 mph). Personal injury may result from excessive wheel spinning.
  - — All persons should stay clear of the rotating components and the balance weight areas in order to avois possible personal injury.
  - — When running an engine in the repair stall for an extrended period of time, use care not to overheat the engine and the transmission.
- When a test requires jacking up the vehicle and running with the wheels and brake rotors removed, adhere to the following precautions:
  - — Do not apply the brake with the brake rotors removed.
  - — Do not place the transmission in PARK with the wheels still spinning.
  - — Turn off the ignition in order to stop the powertrain components from spinning.

Defective Scan Tool Notice

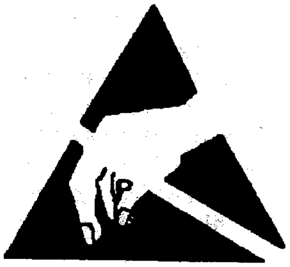
NOTICE: *Do not use a scan tool that displays faulty data. Report the scan tool problem to the manufacturer. Use of a faulty scan tool can result in misdiagnosis and unnecessary parts replacement.*

Fastener Notice

NOTICE: ***Always use the correct fastener in the proper location. Replacement fasteners must be the correct part number for that application. Fasteners requiring replacement or requiring the use of thread locking compound or sealant are identified in the service procedure. Do not use paints, lubricants, or corrosion inhibitors on fasteners or fastener joint surfaces unless specified. These coatings affect fastener torque and joint clamping force and may damage the fastener. Use the correct tightening sequence and specifications when installing fasteners in order to avoid damage to parts and systems.***

Handling ESD Sensitive Parts Notice

NOTICE



CONTENTS SENSITIVE
TO
STATIC ELECTRICITY

CHN0010A

Electrostatic Discharge (ESD) can damage many solid state electrical components. Not all components that are susceptible to damage from ESD are labeled with the ESD symbol. Exercise caution when handling all solid state electrical components Avoid damaging solid state electrical components by taking the following precautions:

- Discharge personal static electricity by touching a metal ground point after each of the following activities:
  - — Slide across the vehicle seat
  - — Sitting or rising
  - — Walking
- Do not touch the exposed electrical terminals on a component with your finger or a tool. The connector that you are checking may be tied into a circuit that is susceptible to damaged by ESD.
- Do not allow a screwdriver or similar tool to contact exposed terminals when disconnecting a connector.
- Do not remove the protective packaging of the solid state component until you are ready to install the solid state component.
- Unless specified in a particular diagnostic procedure, avoid the following activities:
  - — jumpering components or connectors
  - — grounding components or connectors

Sensing and Diagnostic Module (SDM) Notice

NOTICE: ***If the vehicle has been exposed to extensive water intrusion, such as water leaks, window left open, driving through high water and so forth, the Sensing and Diagnostic Module (SDM) and the SDM connector may need to be replaced. With the ignition "OFF," inspect the area under the front seat and the area around the SDM, including the carpet. If any significant soaking or evidence of significant soaking is detected, the water must be removed, water damage repaired and the SDM and the SDM connector MUST be replaced. Before attempting any of these repairs, the SIR system must be disabled. Refer to SECTION 9J under "ON-VEHICLE SERVICE" for instructions on how to disable the SIR system and replace the SDM and SDM connector.***

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SECTION 6

DRIVE MOTOR

GENERAL DESCRIPTION

The differential is part of the drive motor assembly. The differential allows the wheels to turn at different rates of speed while the front drive motor continues to transmit the driving force. This prevents tire scuffing and premature wear on internal drive motor parts.

DIAGNOSIS OF FRONT DRIVE MOTOR NOISE

NOTICE: ***The front suspension SHOULD NOT be allowed to hang free. When the CV joint is run at a very high angle, extra vibrations can occur, resulting in damage to seals and joints. Always follow equipment manufacturer's instructions.***

Any gear-driven unit produces a certain amount of noise that is normal and cannot be eliminated by conventional repairs or adjustments. Slight noise that is heard only at a certain speed or under unusual or remote conditions is acceptable. For example, a noise that tends to reach a peak at speeds from 60 to 100 km/h (40 to 60 mph) depending on road conditions, load conditions, or tire size, does not indicate trouble in the drive motor assembly.

When a drive motor is suspected of being noisy, check to determine whether the noise originates in the tires, road surface, wheel bearings, or drive motor assembly. Raising tire pressure to eliminate tire noise (although this will not silence tread noise of mud and snow tires), and listening for the noise at varying speeds and road surfaces, on drive, float, and coast conditions will help to locate the source of the noise.

DETERMINING THE SOURCE OF THE NOISE

Road Noise —Some road surfaces, such as brick or rough-surfaced concrete, cause noise that may be mistaken for tire or drive motor noise. Driving on a different type of road, such as smooth asphalt or dirt, will quickly show whether the road surface is the cause of the noise. Road noise is usually the same on drive or coast.

- Check tires for irregular wear.
- Check tire pressure.
- Check drive motor lubricant level.
- Drive to warm up the drive motor.
- Test at various speeds in drive, float, coast, and while cornering.

Tire Noise —Tire noise may easily be mistaken for drive motor noise. Tire noise, however, changes with different road surfaces. Drive motor noise does not. Temporarily inflating all tires to 345 kPa (50 psi) pressure before test purposes only will materially alter noise caused by tires but will not affect noise caused by the drive motor. Noise usually stops when coasting at speeds under 48 km/h (30 mph); however, tire noise continues with lower tone as the vehicle speed is reduced.

- Change the tire pressure to minimize noises.
- Drive on different road surfaces.
- Drive on smooth black-top to minimize tire noise.
- Cross switch the tires, if necessary.
- Remember that snow tire treads and studs cause added noises.

Wheel Bearing Noise —A brinelled wheel bearing causes a knock or click approximately every two revolutions of the wheel, because the bearing rollers do not travel at the same speed as the drive motor and wheel. With the wheels "Raised", spin the wheels by hand while listening at the hubs for evidence of a rough or brinelled wheel bearing, or loose bearings.

1. Drive the vehicle at low speed on a smooth road.
2. Drive the vehicle, turning to the left and right. Noise should change due to cornering loads.
3. Raise up the wheels to verify roughness at the wheels.

Gear Noise —There are two basic types of gear noise. The first type produced by broken, bent, or forcibly damaged gear teeth, is usually quite audible over the entire speed range, and presents no difficulty in diagnosis. For example, hypoid gear tooth scoring generally results from the following: insufficient lubricant, improper lubricant, improper break-in, wrong lubricant, insufficient gear backlash, improper ring and pinion alignment, or loss of drive pinion nut torque. The scoring will progressively lead to complete erosion of the gear tooth or gear tooth pitting and then eventual fracture if the initial scoring is not corrected. Another cause of hypoid gear fracture is extended overloading of the gear set. This will produce fatigue fracture, or shock loading, and will result in sudden failure.

The second type of gear noise pertains to the mesh pattern of the gear teeth. This form of abnormal gear noise can be recognized because it produces a cycling pitch (whine) and will be very pronounced in the speed range at which it occurs, appearing under either drive, float, or coast conditions. Gear noise tends to peak in a narrow speed range or ranges, and will tend to remain constant in pitch. Bearing noise will vary in pitch with vehicle speeds.

- Rough running or a whine noise should increase with speed.
- Noise pitch should be higher than differential noise.
- Perform the road test on a smooth road to minimize tire noises.
- Perform the road test at various speeds in drive, float, and coast.

ON-VEHICLE SERVICE

DRIVE MOTOR REPLACEMENT

Removal

Remove or Disconnect (Figures 14 and 15)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Drain the coolant system. Refer to Propulsion System Cooling.
3. Raise the vehicle on a hoist.
4. Remove drive axles from drive motor. Refer to Front Driving Axle.
5. Remove the A/C compressor wire bracket.
6. Disconnect Electrical leads to motor.
7. Remove two coolant lines from motor. Refer to Propulsion System Cooling.
8. Remove shift cable from motor. Refer to Shift Cable.

Install or Connect

9. Install motor adapter J 42199 to transmission jack or tool J 42187.
10. Raise jack to motor and strap motor to jack.

Remove or Disconnect

11. Remove three motor mounting bolts.
12. Remove motor from vehicle by lowering jack.

Installation

Install or Connect (Figures 14 and 15)

1. Raise motor into position with transmission jack and adapter J 42199.
2. Install motor mounts with three mounting bolts.

Tighten

- Tighten drive motor mount nuts to 85 N.m (63 lb ft).

3. Install shift cable to motor. Refer to Shift Cable.
4. Install two coolant lines to motor. Refer to Propulsion System Cooling.
5. Connect electrical leads to motor.
6. Install A/C compressor wire bracket.
7. Install drive axles. Refer to Front Driving Axle.
8. Lower the vehicle on the hoist.
9. Fill the coolant system. Refer to Propulsion System Cooling.
10. Install the high-voltage disconnect. Refer to Battery Pack Controls.

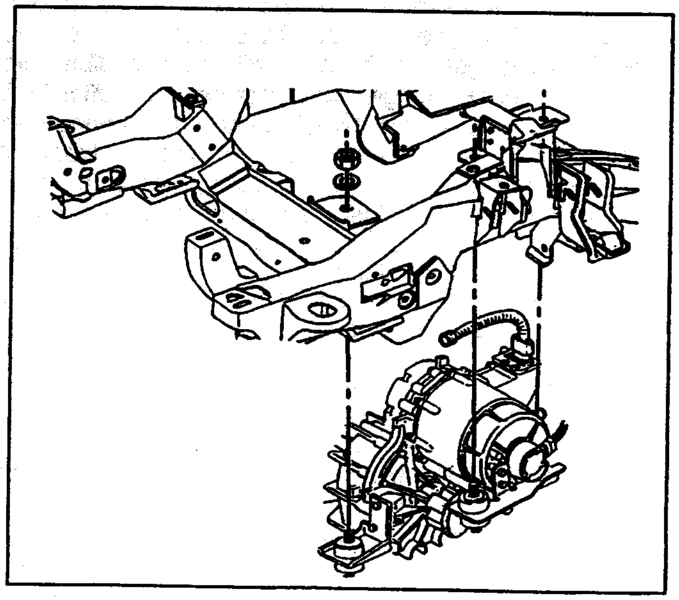


Figure 1—Drive Motor

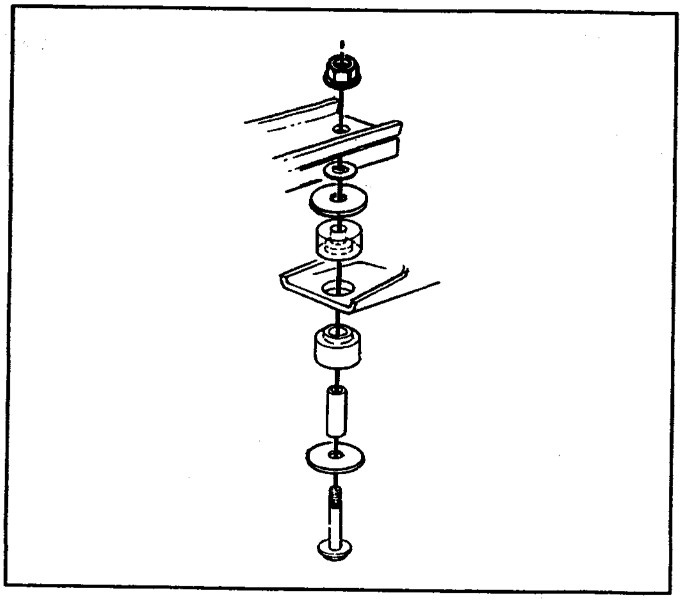


Figure 2—Drive Motor Mount Assembly

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

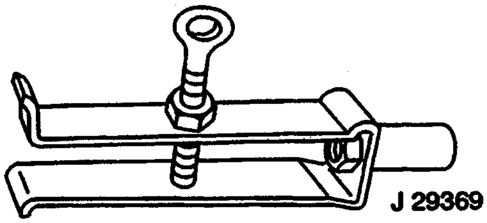
Application	N.m	Lb Ft	Lb In
Drain Plug	26	19	—
Drive Motor Mount Nut	85	63	—

LUBRICATION

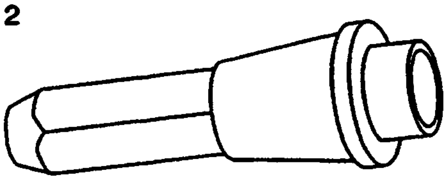
Lubricant	Liters	Quarts
Mobil Infilrex® EV synthetic oil GM P/N 12371288 or equivalent	1.65	1.75

SPECIAL TOOLS

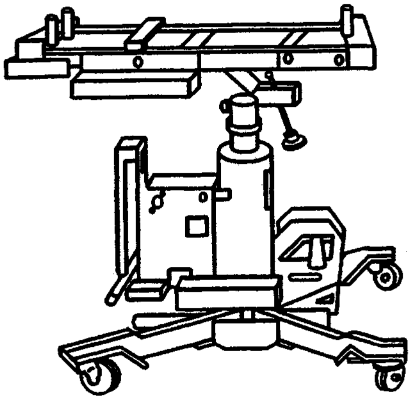
1


J 29369-2

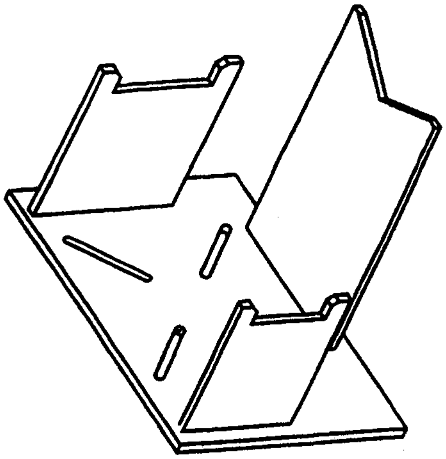
2


EV9719T

3


J 42187

4


J 42199

1. BEARING REMOVER
2. DRIVE UNIT SEAL INSTALLER
3. BATTERY PACK LIFT TABLE
4. DRIVE MOTOR ADAPTER

BLANK

Drive Motor Control Module 6A

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General Description

The Drive Motor Control Module section contains an On-Board Diagnostic (OBD) System Check. The on-board diagnostic system check is an organized approach in order to identify a problem created by a control module system malfunction. The on-board diagnostic system check must be the starting point for any driveability or cruise control complaint diagnosis. The on-board diagnostic system check will direct you to the next logical step in diagnosing the complaint. Understanding the chart and using it correctly will reduce diagnostic time and prevent unnecessary replacement of good parts.

This section applies to the Electric S Truck Drive Motor Control Module.

The Drive Motor Control Module is located inside the Power Inverter Module.

Drive Motor Control Module

The Drive Motor Control Module is designed to process the various input information and then sends the necessary electrical responses to control the Drive Motor. The input information has an interrelation to more than one output, therefore, if one input fails it can affect more than one systems operation.

Fastener Tightening Specifications

Application	N•m	Lb Ft	Lb In
Drive Motor Speed and Direction Sensor Mounting Bolts	10	7	90
Transmission Range Switch Mounting Screws	23	17	204
Transmission Pawl Shaft Lock Nut	23	17	204
Battery Charge Receptacle Mounting Front Mounting Bolts	10	7	90
Battery Charge Receptacle Mounting Rear Mounting Bolts	10	7	90
Upper Power Inverter Module to Subframe Mounting Bolts	65	48	—
Lower Power Inverter Module to Subframe Mounting nut	32	24	283
Power Steering Control Module Mounting Screws	5.6	4	50
Accessory Power Control Module Mounting Screws	5.6	4	50
Accelerator Pedal Mounting Nuts	10	7	90
APM Positive and Negative Cable Retaining Nuts	18	13	159

Service Parts Group Numbers

Application	GM SPO Group Number
Drive Motor assembly	0.000
Drive Motor Speed and Direction Sensor	3.682
Transmission Range Switch	4.054
Battery Charge Receptacle	2.215
Power Inverter Module	2.200
Power Steering Control Module	6.605
Accessory Power Control Module	2.200
Accelerator Pedal	3.451
Body Control Interface Module	2.560
Power Inverter Module Relay (Run 2)	2.200
Battery Pack Blower Air Flow Sensor	2.212

Typical Scan Tool Data Values

Scan Tool Data - Drive Motor Control Module

Vehicle powered up/Closed Throttle/Park/Acc. OFF/100%TSOC

Scan Tool Parameter	Units Displayed	Typical Data Value
Drive Motor Slip	Hz	0.5
Drive Motor Speed	rpm	0
Vehicle Speed	kph / mph	0
Drive Mtr Current Command	%	1
Drive Mtr Phase Current Input	amps	12.6
TR Switch Mode	Park, Reverse, Neutral, Drive, Error	Park
Drive Mtr Torque Command	%	0
Drive Mtr Shaft Direction	Forward / Reverse	Forward
Drive Mtr Shaft Speed Noisy	Noisy / Not Noisy	Not Noisy
Drive Mtr Slip Direction	Forward / Reverse	Reverse
Drive Mtr Propulsion Status	Normal, Failed, Reduced_Performance	Normal
Drive Mtr Batt Pack Voltage	Volts	330
Auxiliary Battery Voltage	Volts	14.3
Drive Mtr Winding Temp	°C (°F)	~
Pwr Inverter Mod Temp	°C (°F)	~
Cruise Control Set Spd	kph / mph	0
Cruise Operating Mode	Standby, Accelerate, Resume, Coast, Cruise, Tap	Standby
Cruise Enable Mode	Off, Enable, Disengage	Disengage
Cruise Driver Override	Driver Override, Not Driver Override	Driver Override
APP Sen.1 (%)	%	0
APP Sen.2 (%)	%	0
App Sen.3 (%)	%	0
App Sen.1 (Volts)	Volts	.741
App Sen.2 (Volts)	Volts	4.251
App Sen.3 (Volts)	Volts	3.939
App Sen.1 Minimum	%	15
App Sen.2 Minimum	%	15
App Sen.3 Minimum	%	21
Accelerator Pedal Position	%	0
Pedal Position Status Flags	Valid, Level 1, Level 2, Level 3	Valid
APP Sen.1 Status Flag	Yes / No	No
APP Sen.2 Status Flag	Yes / No	No
APP Sen.3 Status Flag	Yes / No	No
APP Sen.1 and APP Sen.2 Disagree	Yes / No	No

Vehicle powered up/Closed Throttle/Park/Acc. OFF/100%TSOC (continued)

Scan Tool Parameter	Units Displayed	Typical Data Value
APP Sen.2 and APP Sen.3 Disagree	Yes / No	No
APP Sen.1 and APP Sen.3 Disagree	Yes / No	No
Temperature Lamp Request	ON /OFF	OFF
SERVICE NOW Lamp Request	ON /OFF	OFF
BCA Fault Reset Output	Reset, Not Reset	Reset
SERVICE SOON Telltale Output	ON /OFF	OFF
Bias Fault Input	Yes / No	No
Flash Programming Voltage Output	ON /OFF	OFF
BCA Enable Output	ON /OFF	OFF
SXR Transmit Enable Output	ON /OFF	On
TR Switch A	HIGH / LOW	LOW
TR Switch B	HIGH / LOW	HIGH
TR Switch C	HIGH / LOW	HIGH
TR Switch P	HIGH / LOW	LOW
Regen Disable	Yes / No	Yes
Critical Fault	ON /OFF	No
Non Critical Fault	ON /OFF	No
Run 1	ON /OFF	On
Cruise On/Off	ON /OFF	OFF
Cruise Resume/Accel	ON /OFF	OFF
Cruise Set/Coast	ON /OFF	OFF
Service Brake Switch	ON /OFF	OFF
Interlock Open	Yes / No	No
Connection Present	Yes / No	No
S/W ID	XXXXXXXX	XXXXXXXX

GM

Battery Pack Service Transmittal Sheet

CHEVROLET

ATE

ODEL YEAR

N

ck Serial #

chnical Asst. Case No.

Dealer / Fleet Name

Dealer / Fleet address

Technician Name

Technician Phone

nding Dealer / Fleet:

stomer Complaint:

lated Diagnostic Trouble Codes:

ICM

CM

CM

cent Service History

Please Attach A Copy of All Relevant Repair Orders

Battery Pack Service Transmittal Sheet

DATE ______________________

Technical Asst. Case No. ______________________

Returning Dealer / Fleet:

Dealer / Fleet Name ______________________

Dealer / Fleet address ______________________

____

____

Technician Name. ______________________

Technician Phone ______________________

Repairs completed:

Additional Comments:

Typical Scan Tool Data Definitions

The following information will assist in diagnosing symptom or driveability problems. The displays can be viewed while the vehicle is being driven. Refer to *On Board Diagnostic (OBD) System Check* for additional information.

Scan Tool Display

Drive Motor Slip:

The amount of slip sent to the Bias Control Assembly from the Drive Motor Control Module for motor current command. The greater the slip, the more torque applied to the motor.

Drive Motor Speed:

The speed the drive motor rotor is turning as measured by the speed and direction sensor.

Vehicle Speed:

The vehicle speed calculated by the Drive Motor Control Module. The Drive Motor Control Module receives this signal from the Bias Control Assembly which receives his input from the speed/direction sensor.

Drive Mtr Current Command:

This is a Pulse Width Modulated output signal from the Drive Motor Control Module to the Bias Control Assembly and represents the commanded current value o control the drive motor.

Drive Mtr Phase Current Input:

This is an analog signal that represents the AC current measured at the output to the drive motor.

TR Switch Mode:

This signal represents the position the Drive Motor Control Module sees from the Transmission Range Switch on the Drive Motor.

Drive Mtr Torque Command:

Displays the torque command based on the inputs.

Drive Mtr Shaft Direction:

This signal is received by the Drive Motor Control Module from the Bias Control Assembly. The Drive Motor Control Module can determine vehicle direction by he amplitude of the signal. Above 2000 RPM the signal s filtered.

Drive Mtr Shaft Speed Noisy:

Displays NOISY when one of the two conditions have been met:

Shaft speed is greater than 2000 RPM and a change in shaft direction was seen in 8 milliseconds.

The shaft speed has increased or decreased more than 2000 RPM in 8 milliseconds.

Drive Mtr Slip Direction:

This represents the commanded slip direction from the Drive Motor Control Module to the Bias Control Assembly. Two slip signals are sent to the Bias Control Assembly. The Drive Motor Control Module sends a signal to the BCA to command the slip frequency and direction.

Drive Mtr Propulsion Status:

This represents the state of the Drive Motor Control Module operation.

Drive Mtr Batt Pack Voltage:

This represents the battery pack voltage as read by a scaled input (1V=100V) to the Drive Motor Control Module.

Auxiliary Battery Voltage:

This represents the auxiliary battery voltage as seen at the Drive Motor Control Module input.

Drive Mtr Temp:

This represents the temperature of the motor stator windings as read by the Drive Motor Control Module.

Pwr Inverter Mod Temp:

This represents the temperature at the cold plate of the Power Inverter Module as read by the Bias Control Assembly and sent to the Drive Motor Control Module for display.

Cruise Control Set Spd:

Displays the vehicle speed when cruise was selected.

Cruise Operating Mode:

Displays current status as seen by the Drive Motor Control Module as follows:

- STANDBY equals the following:
  - Not in Cruise Control
  - Cruise switch off
  - Vehicle speed is less than 30 MPH
  - Drive Motor Control Module sees service brake input
- CRUISE equals driving with the Cruise Control set.
- ACCEL/COAST/RESUME/TAP equals the functions of the Cruise Control switch.

Cruise Enable Mode:

Displays the mode of operation as seen by the Drive Motor Control Module.

Cruise Driver Override:

Displays DRIVER OVERRIDE when a driver input is activated to disable the Cruise Control (when using the accelerator pedal during cruise mode).

APP Sen.1 (%):

Displays the accelerator position in a percentage. The percentage is converted from APP Sen.1 by the Drive Motor Control Module (5% equals closed throttle and 92% equals WOT).

APP Sen.2 (%):

Displays the accelerator position in a percentage. The percentage is converted from APP Sen.2 by the Drive Motor Control Module (9% equals WOT and 95% equals closed throttle).

App Sen.3 (%):

Displays the accelerator position in a percentage. The percentage is converted from APP Sen.3 by the Drive Motor Control Module (32% equals WOT and 86% equals closed throttle).

App Sen.1 (Volts):

The APP sensor is a primary sensor to the Drive Motor Control Module which indicates the demand from the operator of the vehicle. The sensor contains three individual sensors that are scaled differently. The APP Sen.1 Range is 0.25-95 Volts at closed throttle and 3.4-3.6 Volts at WOT.

App Sen.2 (Volts):

The APP sensor is a primary sensor to the Drive Motor Control Module which indicates the demand from the operator of the vehicle. The sensor contains three individual sensors that are scaled differently. The APP Sen.2 Range is 4-4.75 Volts at closed throttle and 1.4-1.6 Volts at WOT.

App Sen.3 (Volts):

The APP sensor is a primary sensor to the Drive Motor Control Module which indicates the demand from the operator of the vehicle. The sensor contains three individual sensors that are scaled differently. The APP Sen.3 Range is 3.65-4.35 Volts at closed throttle and 2.1-2.3 Volts at WOT.

App Sen.1 Minimum:

Displays the minimum APP that the Drive Motor Control Module has learned. The Drive Motor Control Module will learn the minimum APP at each power-up. Starts at 100% and scales down to current pedal rest position. This new APP value will have to be exceeded in order to apply torque to the motor.

App Sen.2 Minimum:

Displays the minimum APP that the Drive Motor Control Module has learned. The Drive Motor Control Module will learn the minimum APP at each power-up. Starts at 100% and scales down to current pedal rest position. This new APP value will have to be exceeded in order to apply torque to the motor.

App Sen.3 Minimum:

Displays the minimum APP that the Drive Motor Control Module has learned. The Drive Motor Control Module will learn the minimum APP at each power-up. Starts at 100% and scales down to current pedal rest position. This new APP value will have to be exceeded in order to apply torque to the motor.

Accelerator Pedal Position:

Displays the position of the accelerator pedal based on the operator's input (0% equals closed throttle and 100% equals WOT).

Pedal Position Status Flags:

Displays the state of the accelerator pedal as defined by the Drive Motor Control Module inputs.

APP Sen.1 Status Flag:

Displays YES if the Drive Motor Control Module detects a failure with APP Sen.1.

APP Sen.2 Status Flag:

Displays YES if the Drive Motor Control Module detects a failure with APP Sen.2.

APP Sen.3 Status Flag:

Displays YES if the Drive Motor Control Module detects a failure with APP Sen.3.

APP Sen.1 and APP Sen.2 Disagree:

The Drive Motor Control Module determines failures of the APP sensors by comparing voltage levels. If the voltage levels of two sensors do not represent the same pedal position, the Drive Motor Control Module will set a DTC and display YES.

APP Sen.2 and APP Sen.3 Disagree:

The Drive Motor Control Module determines failures of the APP sensors by comparing voltage levels. If the voltage levels of two sensors do not represent the same pedal position, the Drive Motor Control Module will set a DTC and display YES.

APP Sen.1 and APP Sen.3 Disagree:

The Drive Motor Control Module determines failures of the APP sensors by comparing voltage levels. If the voltage levels of two sensors do not represent the same pedal position, the Drive Motor Control Module will set a DTC and display YES.

Temperature Lamp Request:

Displays ON when a request for the temperature telltale to turn on is made (ON when TEMP telltale is being commanded by the BPCM, or Drive Motor Control Module).

SERVICE NOW Lamp Request:

Displays ON when the SERVICE NOW telltale is commanded on by the BPCM, HTCM, or Drive Motor Control Module.

Bias Control Assembly Fault Reset Output:

At start-up or if a clear DTC is sent, the Drive Motor Control Module will send this signal to the Bias Control Assembly to clear its fault registers. Displays RESET when the Drive Motor Control Module is clearing the Bias Control Assembly's fault registers.

SERVICE SOON Telltale Output:

Displays ON when a request for the SERVICE SOON telltale has been made by the Drive Motor Control Module, BPCM, HTCM, or EBCM.

Bias Fault Input:

This signal is sent to the Drive Motor Control Module when the Bias Control Assembly detects a fault with the bias supply or when bias voltage is lost. Displays YES when a fault has been detected and the Bias Control Assembly shuts down.

Bias Control Assembly Enable Output:

When the Run mode is selected, the Bias Control Assembly powers up for drive motor control. When the Drive Motor Control Module determines that propulsion needs to be enabled the output is turned on. Displays YES when propulsion is enabled.

SXR Transmit Enable Output:

Displays ON when the Drive Motor Control Module is sending out serial data.

TR Switch Input A:

Displays the individual Transmission Range Switch nputs that define the position of the shift selector. LOW ndicates the circuit is pulled to ground. Transmission Range Switch A should indicate LOW when in Park and Reverse.

TR Switch Input B:

Displays the individual Transmission Range Switch nputs that define the position of the shift selector. LOW ndicates the circuit is pulled to ground. Transmission Range Switch B should indicate LOW when in Reverse, Neutral, and Drive.

TR Switch Input C:

Displays the individual Transmission Range Switch nputs that define the position of the shift selector. LOW ndicates the circuit is pulled to ground. Transmission Range Switch C should indicate LOW when in Drive.

TR Switch Input P:

Displays the individual Transmission Range Switch inputs that define the position of the shift selector. LOW indicates the circuit is pulled to ground. Transmission Range Switch P (Parity) should indicate LOW when in Park and Neutral.

Regen Disable:

The EBCM will request that Regen be disabled during ABS braking. Displays YES when the Drive Motor Control Module receives a Regen disable request from the EBCM.

Critical Fault:

When the Bias Control Assembly detects a critical fault, it will send this signal to the Drive Motor control Module and the Drive Motor Control Module will set the critical fault line to YES. The Drive Motor Control Module will set the DTCs.

Non Critical Fault:

When the Bias Control Assembly detects a non-critical fault, it will send this signal to the Drive Motor Control Module and the Drive Motor Control Module will set the non-critical fault line to YES. The Drive Motor Control Module will set the DTCs.

RUN 1:

Displays ON when the Drive Motor Control Module receives the Run 1 signal from the ignition switch. If the Drive Motor Control Module loses run 1, a loss of communication will occur.

Cruise On/Off:

Displays ON when the cruise switch is turned to the ON position.

Cruise Resume/Accel:

ON only when the cruise Resume/Accel switch is depressed.

Cruise Set/Coast:

ON only when the cruise Set/Coast switch is depressed and the cruise switch in ON.

Service Brake Switch:

ON only when the brake switch is depressed.

Interlock Open:

Displays the interlock loop status as seen by the Drive Motor Control Module. Will read NO until a fault is detected or the high voltage disconnect has been disconnected.

Connection Present:

Displays YES when the Drive Motor Control Module detects that the charge paddle is present in the charge receptacle.

S/W ID:

Displays the 8-digit number for identifying the Drive Motor Control Module software. If all values are F, then download new software.

S/W CHECKSUM:

Displays the software checksum. If all values are F, then download new software.

Ignition On Timer:

Displays the number of minutes that the vehicle was in the RUN/ACC mode before the DTC set.

True State of Charge:

The actual pack state of charge when the DTC set.

User State of Charge:

State of charge value 15% less then true SOC.

Battery Pack Current:

Displays what the Battery Pack Control Module was reading as current at the time of failure.

Veh Acceleration:

Displays the acceleration or deceleration at the time the DTC set.

HV Interlock:

Displays YES when the Drive Motor Control Module detects an interlock failure.

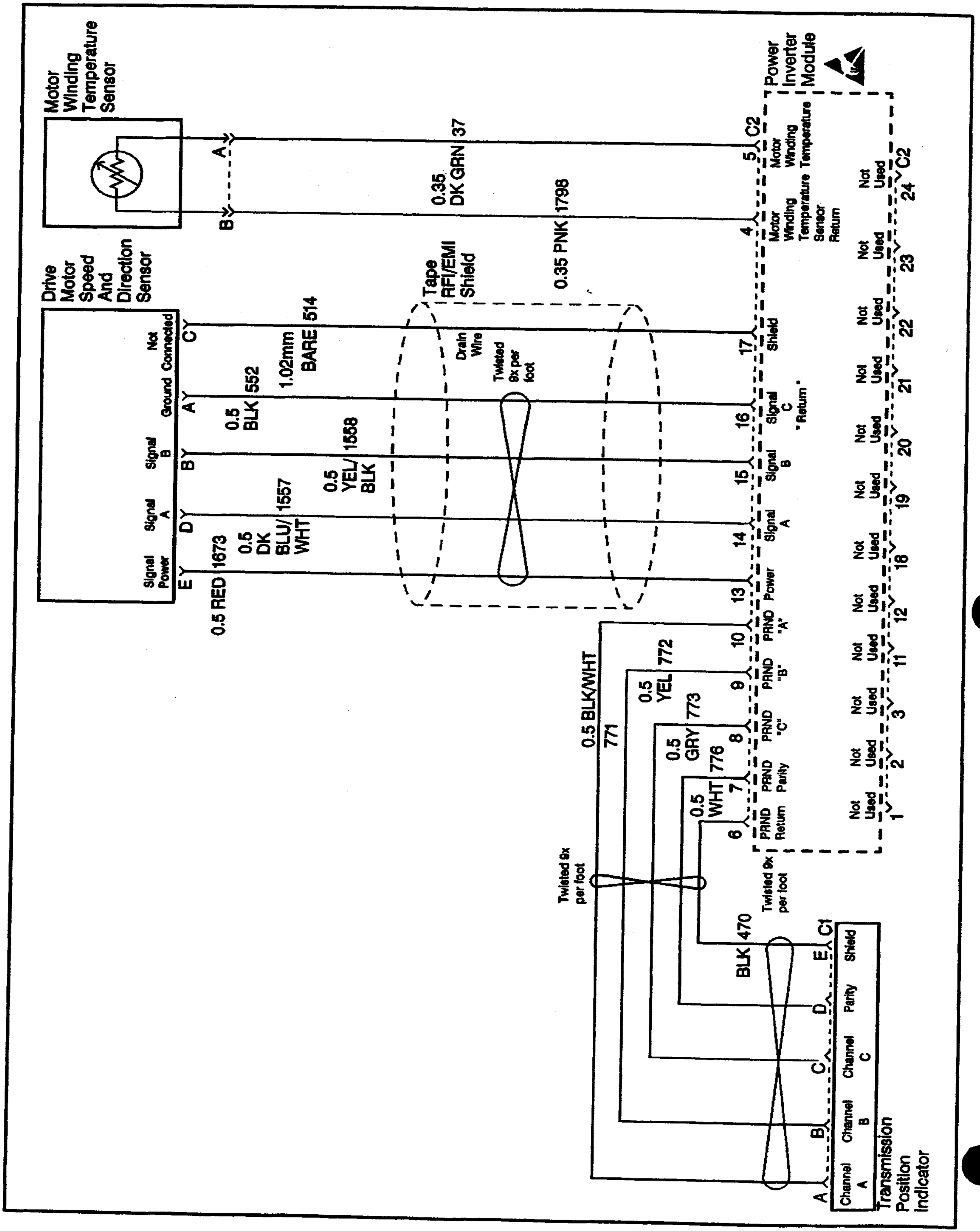
Propulsion System Status:

Displays the status of the vehicle as determined by the Drive Motor Control Module.

Propulsion State:

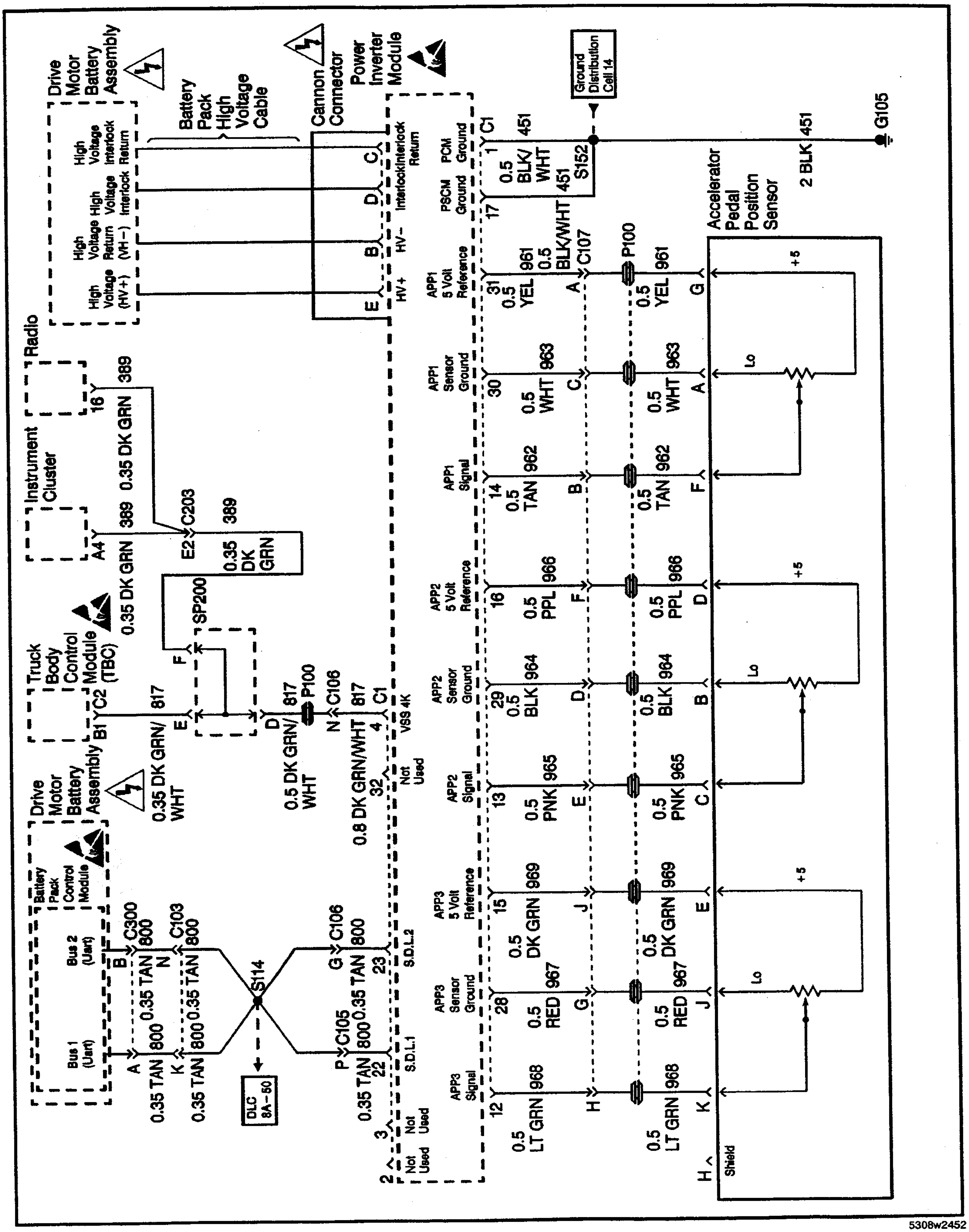
Displays the current state of the Drive Motor Control Module operation.

Wiring Diagram - (1 of 15)


Motor Winding Temperature Sensor
A
B
0.35 DK GRN 37
0.35 PNK 1798
Power Inverter Module
C2
5 Motor Winding Temperature
4 Motor Winding Temperature Sensor Return
Drive Motor Speed And Direction Sensor
Not Connected C
Ground A
Signal B B
Signal A D
Signal Power E
1.02mm BARE 514
0.5 BLK 552
0.5 YEL/BLK 1558
0.5 DK BLU/WHT 1557
0.5 RED 1673
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
17 Shield
16 Signal C "Return"
15 Signal B
14 Signal A
13 Power
10 PRND "A"
9 PRND "B"
8 PRND "C"
7 PRND Parity
6 PRND Return
0.5 BLK/WHT 771
0.5 YEL 772
0.5 GRY 773
0.5 WHT 776
BLK 470
Not Used 24
Not Used 23
Not Used 22
Not Used 21
Not Used 20
Not Used 19
Not Used 18
Not Used 12
Not Used 11
Not Used 3
Not Used 2
Not Used 1
Twisted 9x per foot
Twisted 9x per foot
C1
Transmission Position Indicator
A Channel A
B Channel B
C Channel C
D Parity
E Shield

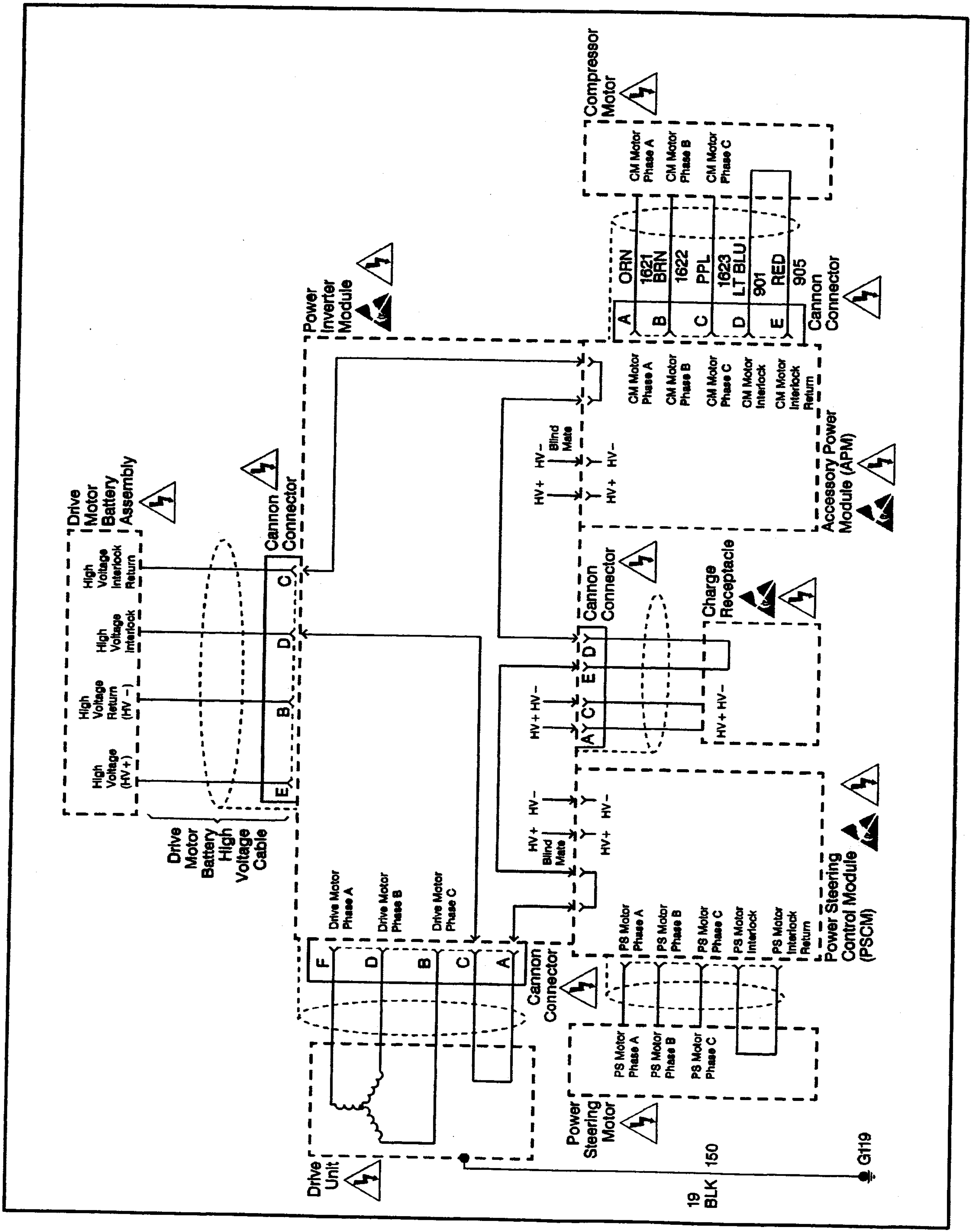
5308w2453

Wiring Diagram - (2 of 15)


Drive Motor Battery Assembly
High Voltage (HV+)
High Voltage Return (VH–)
High Voltage Interlock
High Voltage Interlock Return
Battery Pack High Voltage Cable
Cannon Connector
Power Inverter Module
E
B
D
C
HV+
HV–
Interlock
Interlock Return
PSCM Ground
PCM Ground
17
1
C1
0.5 BLK/ WHT
451
S152
0.5 BLK/WHT
451
Ground Distribution Cell 14
2 BLK 451
G105
Radio
16
389
0.35 DK GRN
Instrument Cluster
A4
389
E2
C203
389
0.35 DK GRN
0.35 DK GRN
SP200
F
Truck Body Control Module (TBC)
C2
B1
817
E
D
817
P100
C106
N
817
C1
4
0.35 DK GRN/ WHT
0.5 DK GRN/ WHT
0.8 DK GRN/WHT
32
VSS 4K
Not Used
Drive Motor Battery Assembly
Battery Pack Control Module
Bus 1 (Uart)
Bus 2 (Uart)
A
B
C300
800
0.35 TAN
K
N
C103
800
0.35 TAN
S114
DLC 8A-50
P
C105
G
C106
800
0.35 TAN
22
23
S.D.L.1
S.D.L.2
3
2
Not Used
APP1 5 Volt Reference
31
0.5 YEL
961
A
C107
P100
0.5 YEL
961
G
APP1 Sensor Ground
30
0.5 WHT
963
C
0.5 WHT
963
A
APP1 Signal
14
0.5 TAN
962
B
0.5 TAN
962
F
APP2 5 Volt Reference
16
0.5 PPL
966
F
0.5 PPL
966
D
APP2 Sensor Ground
29
0.5 BLK
964
D
0.5 BLK
964
B
APP2 Signal
13
0.5 PNK
965
E
0.5 PNK
965
C
APP3 5 Volt Reference
15
0.5 DK GRN
969
J
0.5 DK GRN
969
E
APP3 Sensor Ground
28
0.5 RED
967
G
0.5 RED
967
J
APP3 Signal
12
0.5 LT GRN
968
H
0.5 LT GRN
968
K
H
Shield
Accelerator Pedal Position Sensor
+5
Lo
+5
Lo
+5
Lo

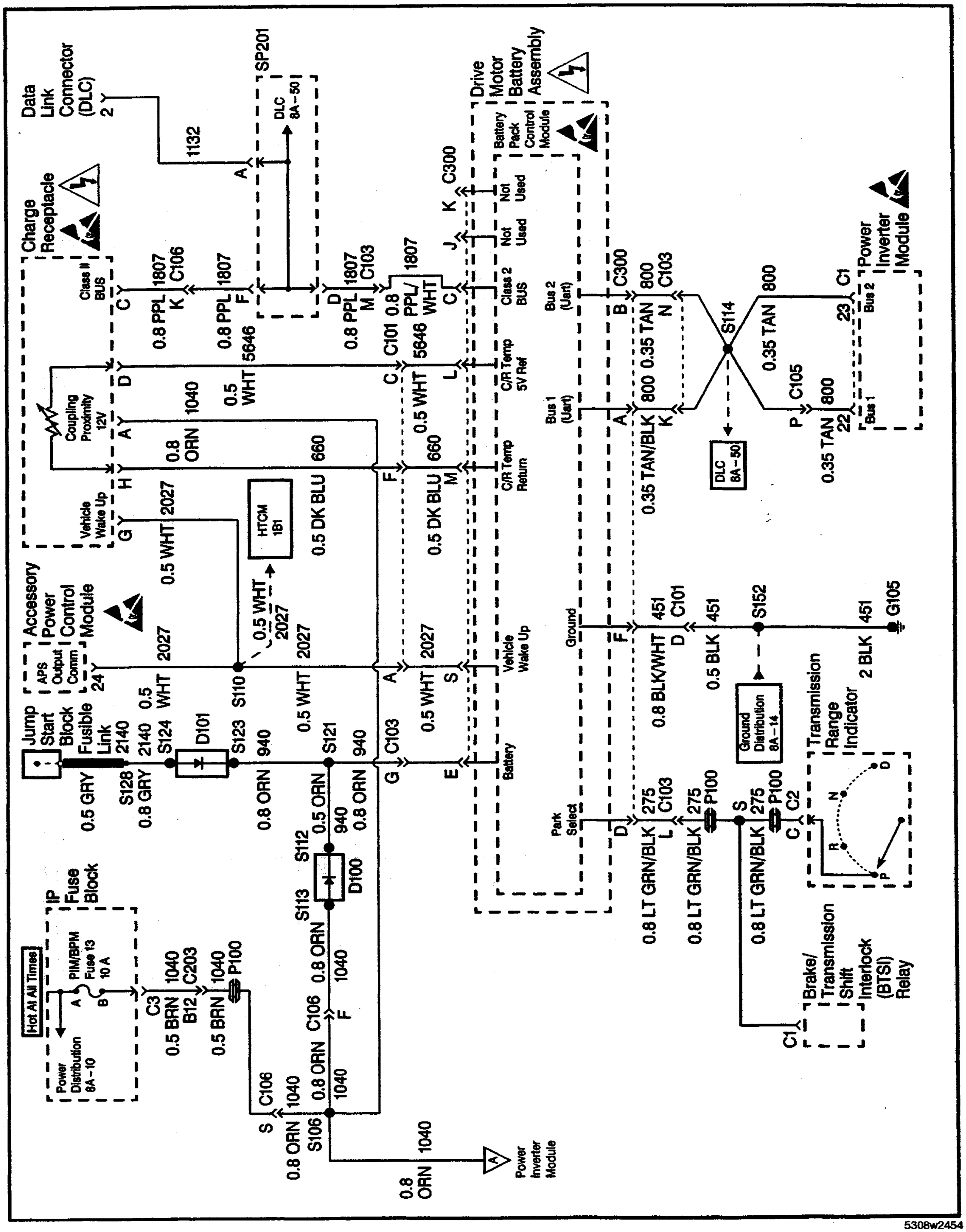
5308w2452

Wiring Diagram - (3 of 15)


Compressor Motor
CM Motor Phase A
CM Motor Phase B
CM Motor Phase C
ORN
1621 BRN
1622 PPL
1623 LT BLU
901 RED
905
A
B
C
D
E
Cannon Connector
Power Inverter Module
CM Motor Phase A
CM Motor Phase B
CM Motor Phase C
CM Motor Interlock
CM Motor Interlock Return
Accessory Power Module (APM)
HV+
HV–
Blind Mate
Drive Motor Battery Assembly
High Voltage Interlock Return
High Voltage Interlock
High Voltage Return (HV –)
High Voltage (HV+)
Cannon Connector
C
D
B
E
Drive Motor Battery High Voltage Cable
Cannon Connector
D
E
C
A
Charge Receptacle
HV+
HV–
Drive Motor Phase A
Drive Motor Phase B
Drive Motor Phase C
F
D
B
C
A
Cannon Connector
PS Motor Phase A
PS Motor Phase B
PS Motor Phase C
PS Motor Interlock
PS Motor Interlock Return
Power Steering Control Module (PSCM)
PS Motor Phase A
PS Motor Phase B
PS Motor Phase C
Power Steering Motor
Drive Unit
19 BLK
150
G119

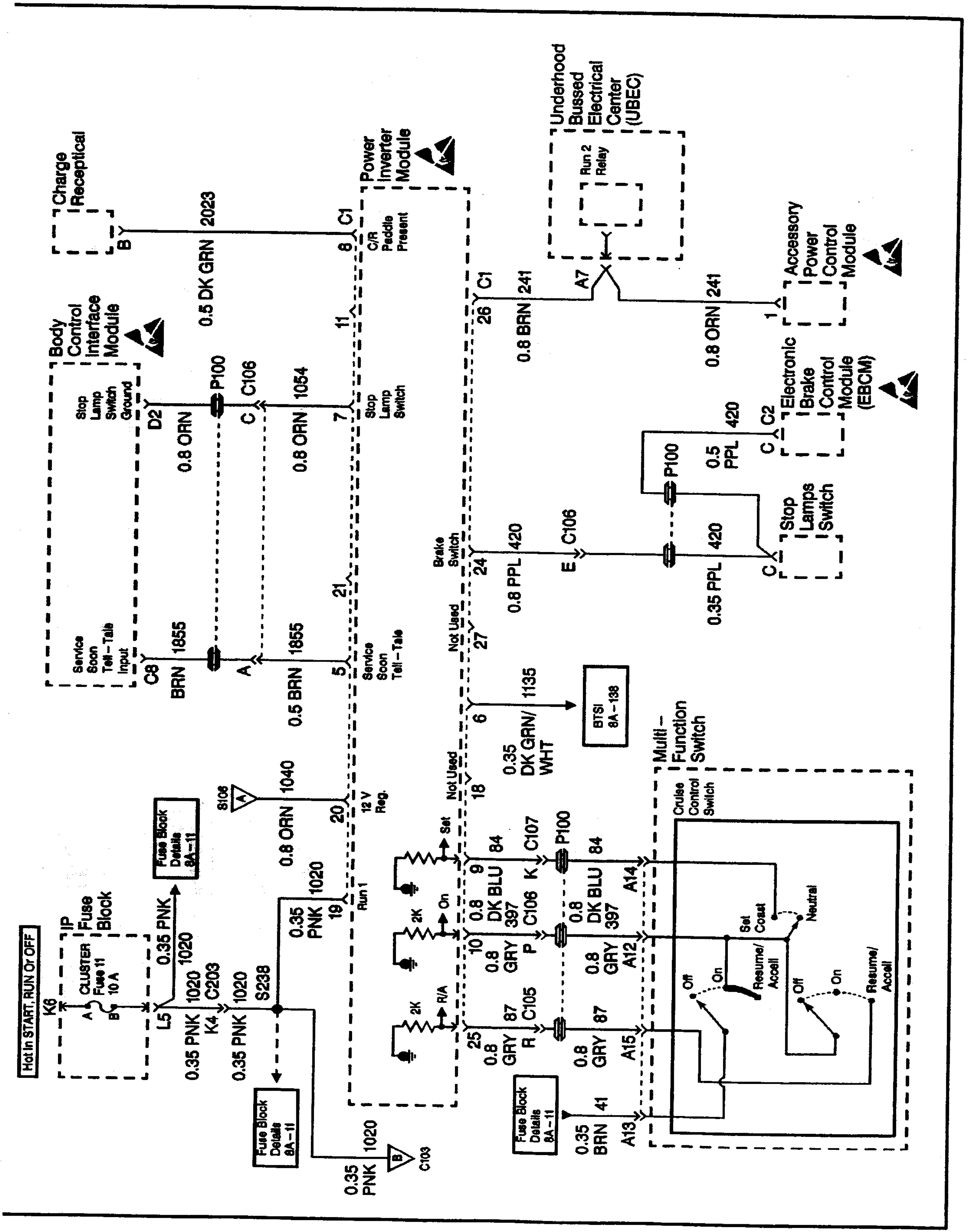
5308w7293

Wiring Diagram - (4 of 15)


Data Link Connector (DLC)
2
1132
A
SP201
DLC 8A-50
Charge Receptacle
Class II BUS
C
1807
K
C106
0.8 PPL
F
D
M
C103
C101
0.8 PPL/WHT
Drive Motor Battery Assembly
Battery Pack Control Module
C300
Not Used
J
Coupling Proximity 12V
D
5646
0.5 WHT
C/R Temp 5V Ref
L
A
1040
0.8 ORN
H
660
0.5 DK BLU
C/R Temp Return
Vehicle Wake Up
G
2027
0.5 WHT
HTCM 1B1
Accessory Power Control Module
APS Output Comm
24
S110
S
Jump Start Block
Fusible Link
2140
0.5 GRY
0.8 GRY
S128
S124
D101
S123
940
0.8 ORN
S121
G
E
Battery
IP Fuse Block
Hot At All Times
PIM/BPM Fuse 13 10 A
Power Distribution 8A-10
C3
0.5 BRN
C203
B12
P100
S112
0.5 ORN
S113
D100
S106
Power Inverter Module
Class 2 BUS
Bus 2 (Uart)
B
800
0.35 TAN
N
S114
Bus 1 (Uart)
0.35 TAN/BLK
DLC 8A-50
C105
P
22
23
C1
Power Inverter Module
Bus 1
Bus 2
Ground
451
0.8 BLK/WHT
0.5 BLK
S152
G105
2 BLK
Ground Distribution 8A-14
Transmission Range Indicator
Park Select
275
0.8 LT GRN/BLK
C2
P
R
N
D
Brake/Transmission Shift Interlock (BTSI) Relay

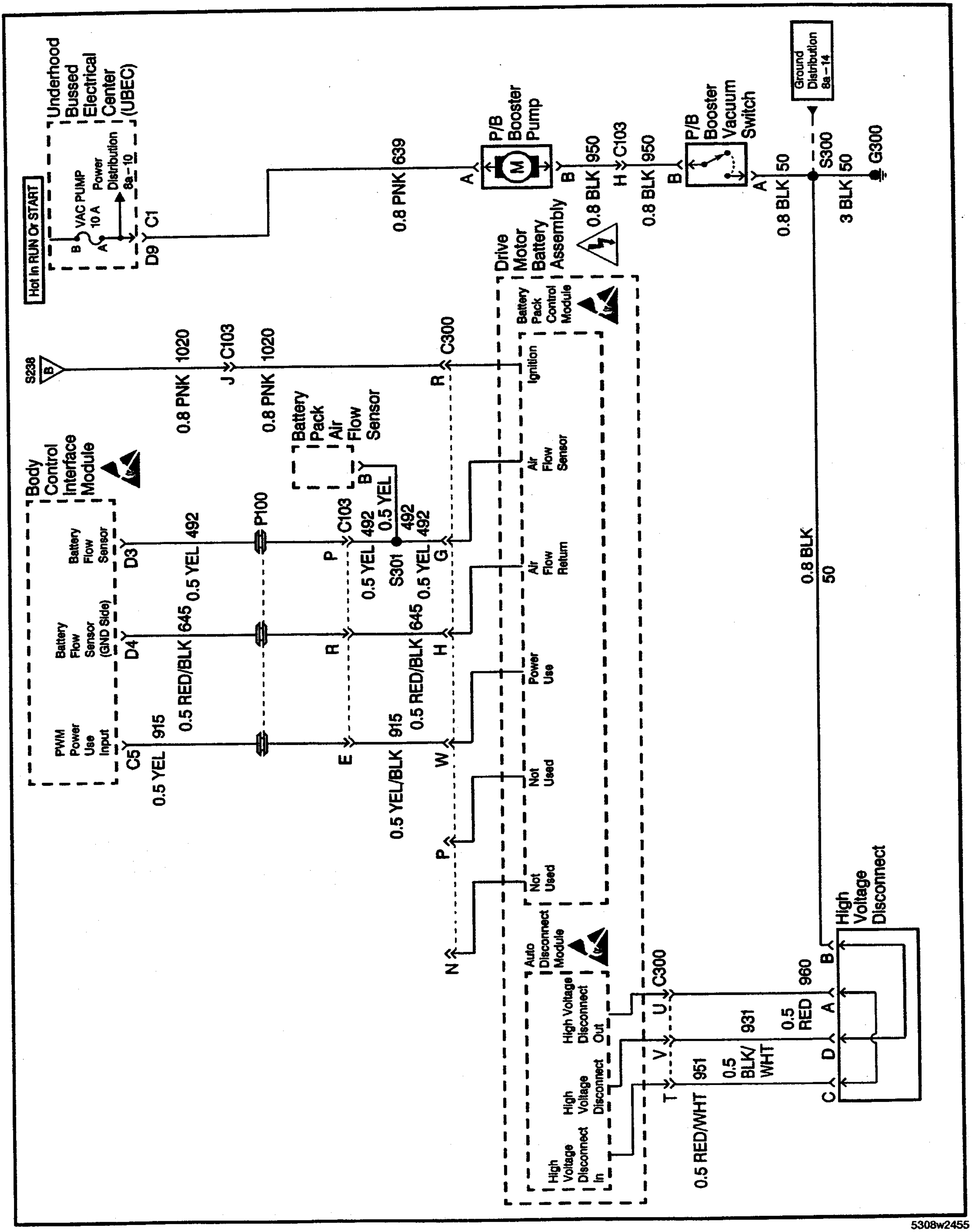
5308w2454

Wiring Diagram - (5 of 15)


Hot In START, RUN Or OFF
IP Fuse Block
CLUSTER Fuse 11 10 A
K6
A
B
L5
0.35 PNK 1020
Fuse Block Details 8A-11
0.35 PNK K4 1020 C203
0.35 PNK 1020 S238
Fuse Block Details 8A-11
0.35 PNK 1020
C103
B
0.35 PNK 1020
19 Run 1
0.8 ORN 1040
S106 A
20 12 V Reg.
Body Control Interface Module
Service Soon Tell-Tale Input
C8 BRN 1855
A
0.5 BRN 1855
5 Service Soon Tell-Tale
21
Stop Lamp Switch Ground
D2 0.8 ORN
P100
C C106
0.8 ORN 1054
7 Stop Lamp Switch
11
Charge Receptical
B
0.5 DK GRN 2023
8 C1 C/R Paddle Present
Power Inverter Module
Set
On
R/A
2K
2K
2K
Not Used
18
6 0.35 DK GRN/ WHT 1135
BTSI 8A-138
27 Not Used
24 Brake Switch
0.8 PPL 420
E C106
26 C1
0.8 BRN 241
Underhood Bussed Electrical Center (UBEC)
Run 2 Relay
A7
0.8 ORN 241
1
Accessory Power Control Module
0.35 PPL 420
C
Stop Lamps Switch
P100
0.5 PPL 420
C C2
Electronic Brake Control Module (EBCM)
9 0.8 DK BLU 84
K C107
P100
0.8 DK BLU 84 A14
10 0.8 GRY 397
P C106
0.8 GRY 397 A12
25 0.8 GRY 87
R C105
0.8 GRY 87 A15
Fuse Block Details 8A-11
0.35 BRN 41 A13
Multi-Function Switch
Cruise Control Switch
Set Coast
Neutral
Off
On
Resume/ Accell
Off
On
Resume/ Accell

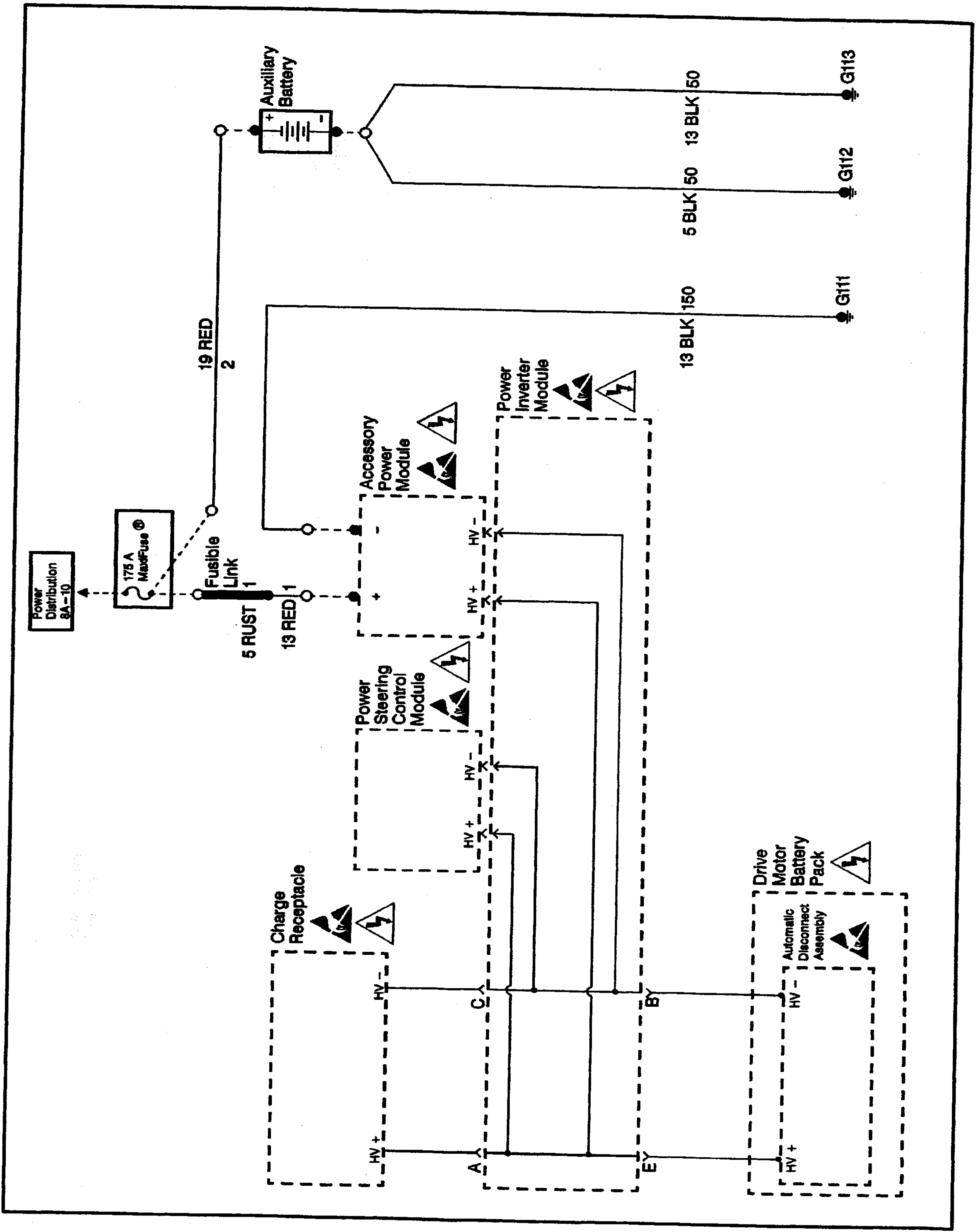
5308w2451

Wiring Diagram - (6 of 15)


Hot In RUN Or START
Underhood Bussed Electrical Center (UBEC)
B
VAC PUMP 10 A
A
Power Distribution 8a-10
C1
D9
0.8 PNK 639
A
P/B Booster Pump
M
B
0.8 BLK 950
H C103
0.8 BLK 950
B
P/B Booster Vacuum Switch
A
0.8 BLK 50
S300
3 BLK 50
G300
Ground Distribution 8a-14
Drive Motor Battery Assembly
Battery Pack Control Module
S238
B
0.8 PNK 1020
J C103
0.8 PNK 1020
R C300
Ignition
Body Control Interface Module
Battery Pack Air Flow Sensor
B
0.5 YEL
Battery Flow Sensor
D3
0.5 YEL 492
P100
P C103
0.5 YEL 492
S301
492
0.5 YEL 492
G
Air Flow Sensor
Air Flow Return
Battery Flow Sensor (GND Side)
D4
0.5 RED/BLK 645
R
0.5 RED/BLK 645
H
Power Use
PWM Power Use Input
C5
0.5 YEL 915
E
0.5 YEL/BLK 915
W
Not Used
P
Not Used
N
0.8 BLK 50
Auto Disconnect Module
High Voltage Disconnect Out
High Voltage Disconnect
High Voltage Disconnect In
C300
U
V
T
0.5 RED 960
0.5 BLK/WHT 931
0.5 RED/WHT 951
High Voltage Disconnect
B
A
D
C

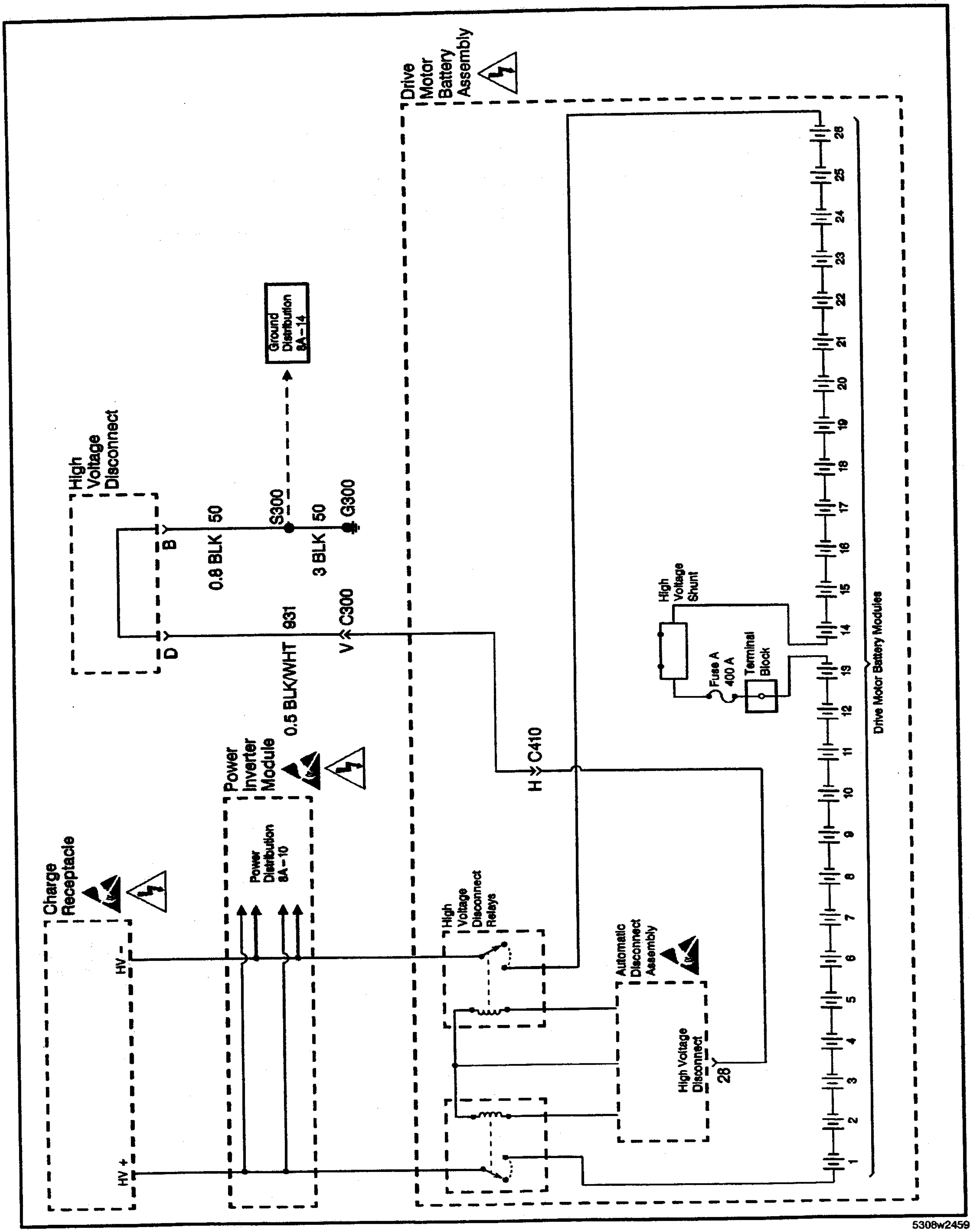
5308w2455

Wiring Diagram - (7 of 15)


Power Distribution 8A-10
175 A MaxiFuse ®
Fusible Link
1
5 RUST
13 RED
1
19 RED
2
Auxiliary Battery
+
-
13 BLK 50
G113
5 BLK 50
G112
13 BLK 150
G111
Accessory Power Module
+
-
HV +
HV -
Power Inverter Module
Power Steering Control Module
HV +
HV -
Charge Receptacle
HV -
HV +
C
A
B
E
Drive Motor Battery Pack
Automatic Disconnect Assembly
HV -
HV +

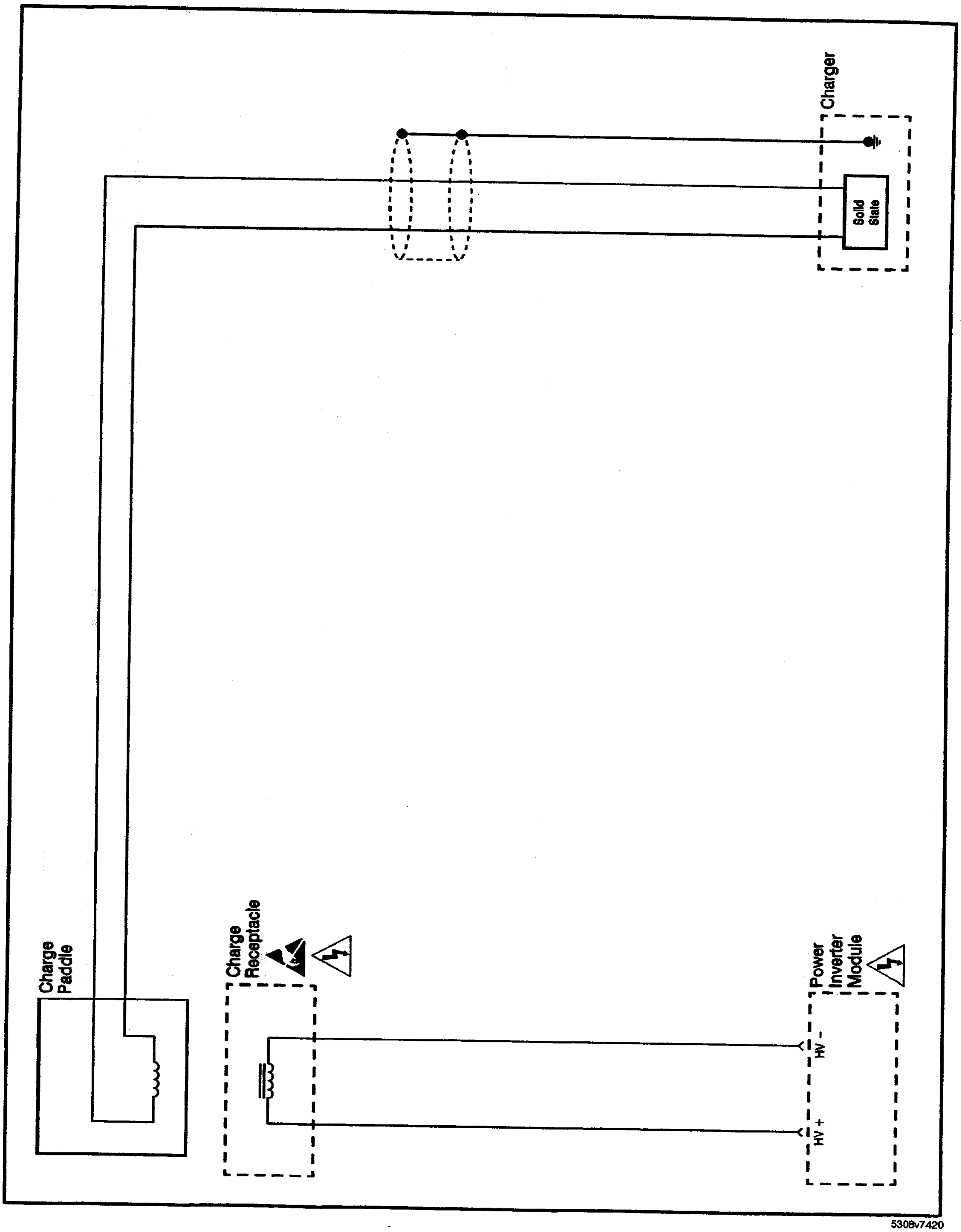
5308w2458

Wiring Diagram - (8 of 15)

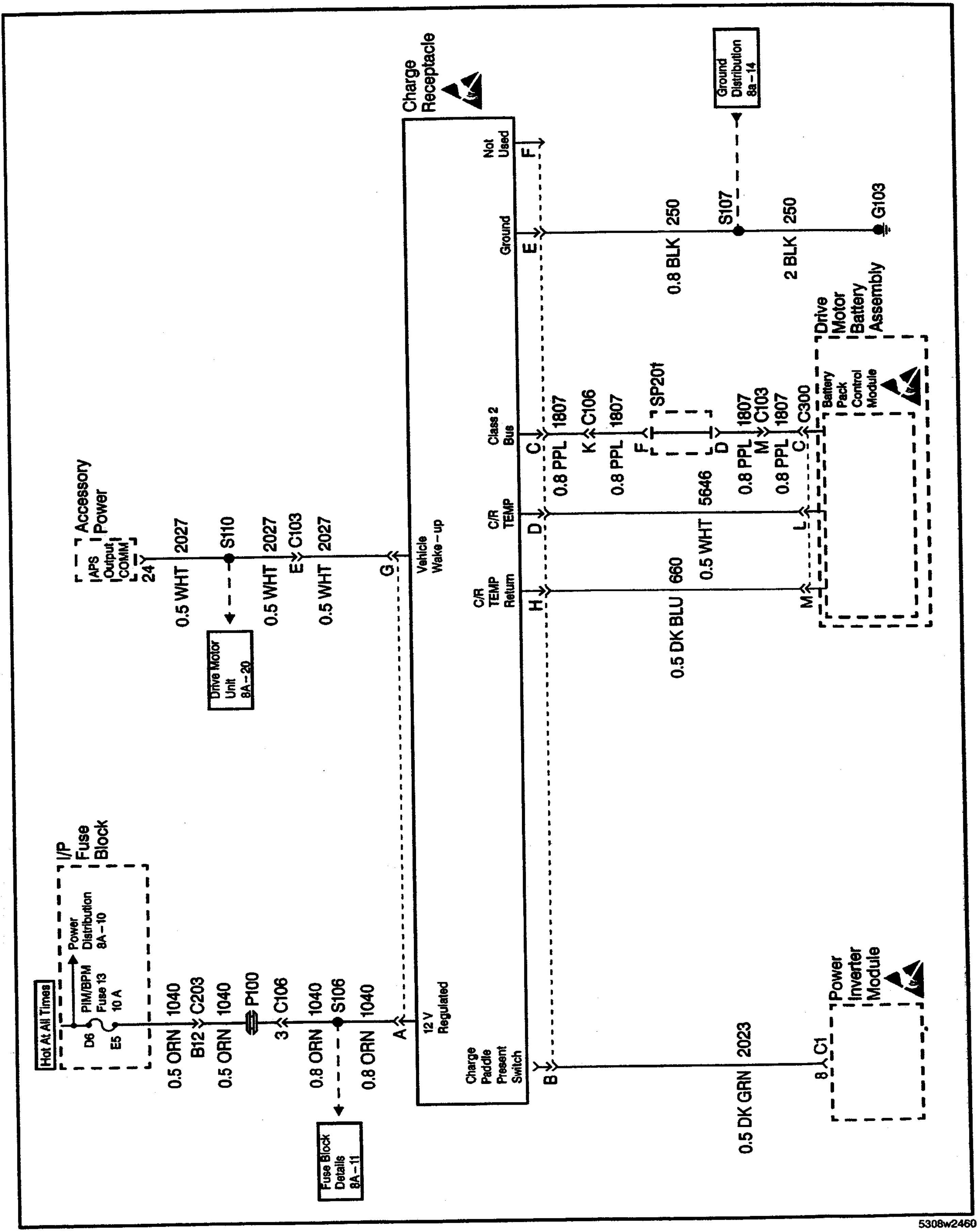

Drive Motor Battery Assembly
High Voltage Disconnect
B
D
0.8 BLK
50
S300
3 BLK
50
G300
Ground Distribution 8A-14
931
0.5 BLK/WHT
V
C300
H
C410
Power Inverter Module
Power Distribution 8A-10
Charge Receptacle
HV -
HV +
High Voltage Disconnect Relays
Automatic Disconnect Assembly
High Voltage Disconnect
28
High Voltage Shunt
Fuse A 400 A
Terminal Block
Drive Motor Battery Modules
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

5308w2459

Wiring Diagram - (9 of 15)

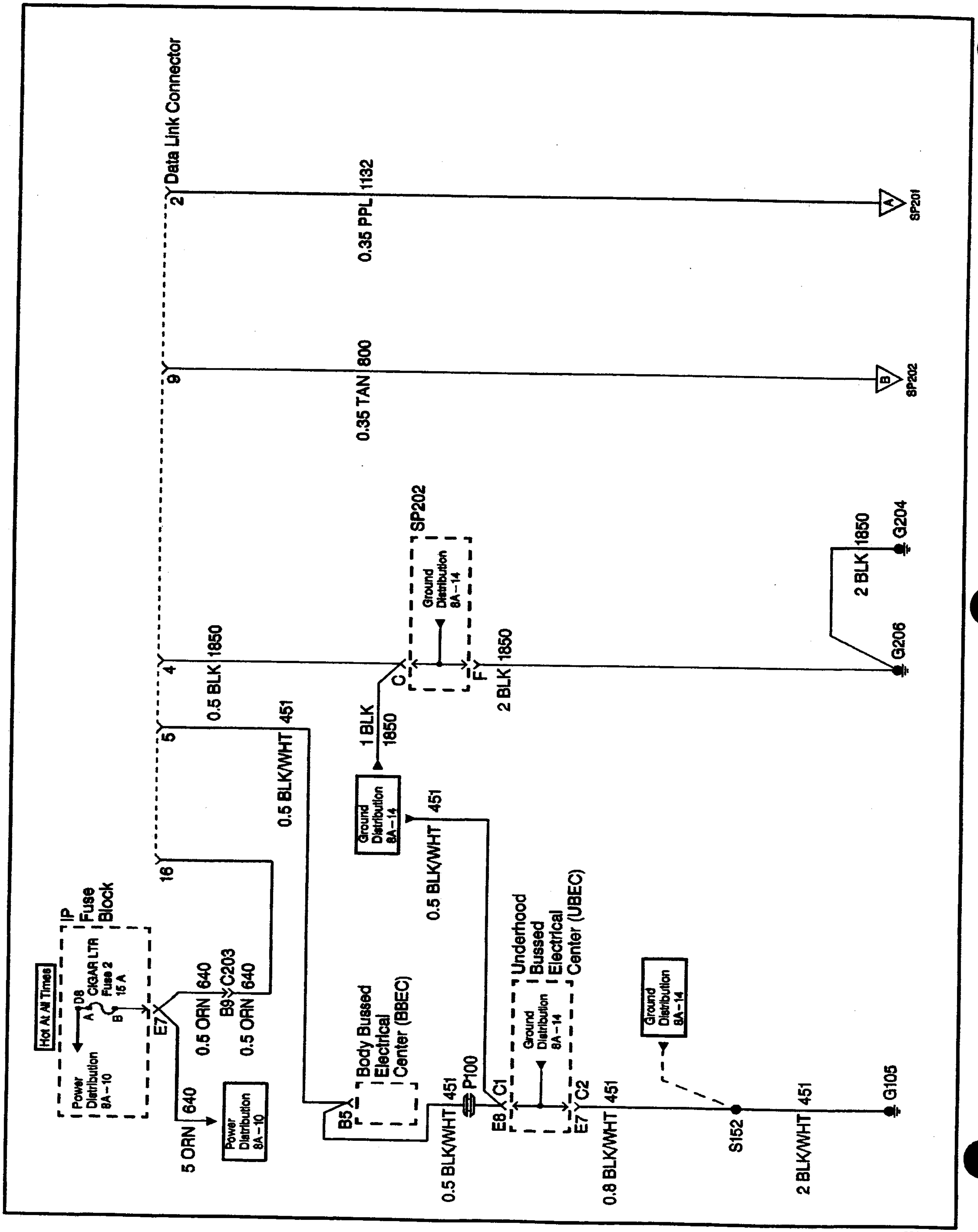

Charger
Solid State
Charge Paddle
Charge Receptacle
Power Inverter Module
HV -
HV +
5308v7420

Wiring Diagram - (10 of 15)


Hot At All Times
I/P Fuse Block
PIM/BPM Fuse 13 10 A
D6
E5
Power Distribution 8A-10
0.5 ORN 1040
B12 C203
0.5 ORN 1040
P100
3 C106
0.8 ORN 1040
S106
0.8 ORN 1040
Fuse Block Details 8A-11
A
12 V Regulated
Charge Paddle Present Switch
Charge Receptacle
APS Output COMM
Accessory Power
24
0.5 WHT 2027
S110
Drive Motor Unit 8A-20
0.5 WHT 2027
E C103
0.5 WHT 2027
G
Vehicle Wake-up
C/R TEMP Return
C/R TEMP
Class 2 Bus
Ground
Not Used
B
H
D
C
E
F
0.5 DK GRN 2023
8 C1
Power Inverter Module
0.5 DK BLU 660
M
0.5 WHT 5646
L
0.8 PPL 1807
K C106
0.8 PPL 1807
F
SP201
D
0.8 PPL 1807
M C103
0.8 PPL 1807
C C300
Battery Pack Control Module
Drive Motor Battery Assembly
0.8 BLK 250
S107
Ground Distribution 8a-14
2 BLK 250
G103

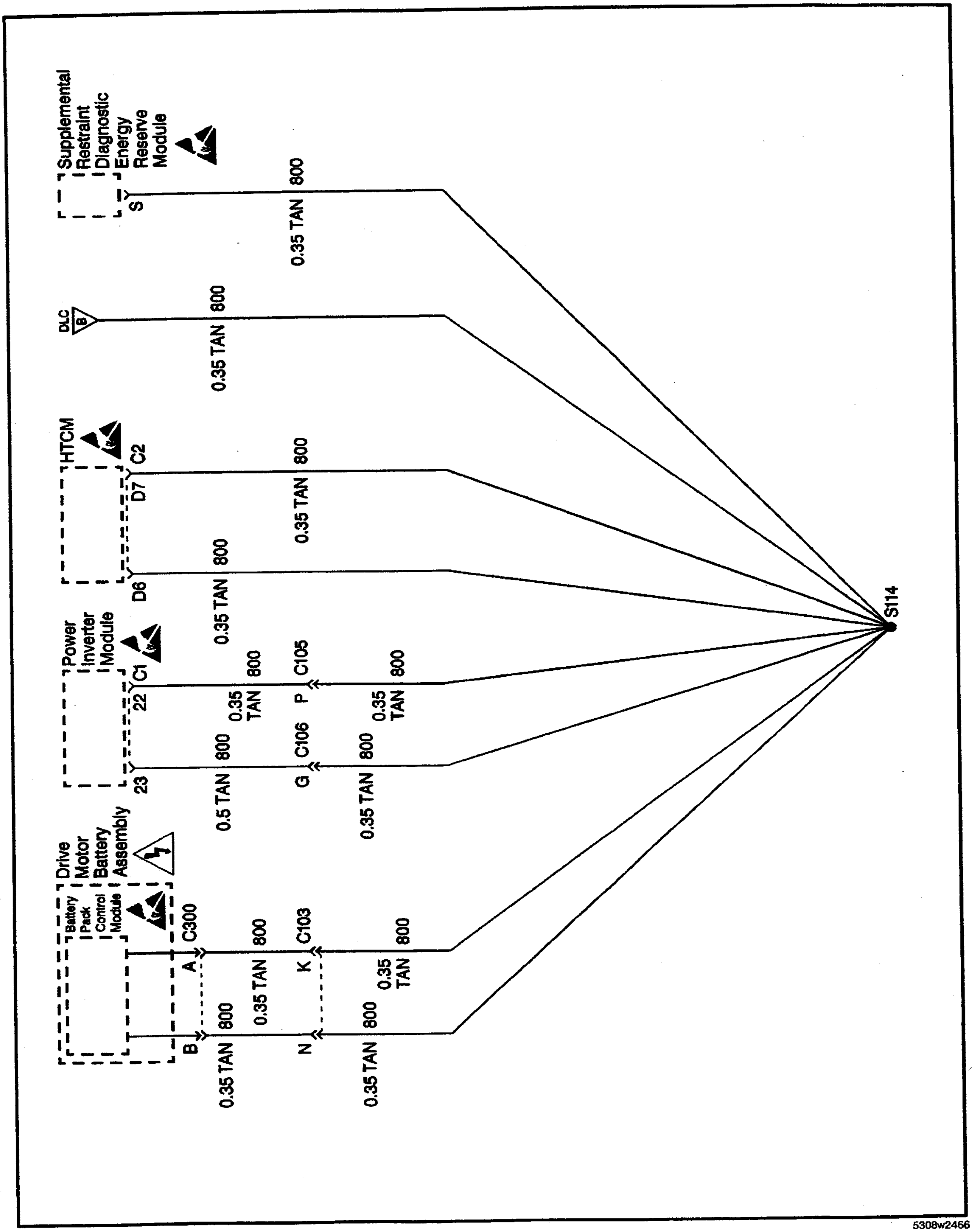
5308w2460

Wiring Diagram - (11 of 15)


Data Link Connector
2
0.35 PPL 1132
A
SP201
9
0.35 TAN 800
B
SP202
4
0.5 BLK 1850
5
0.5 BLK/WHT 451
16
SP202
Ground Distribution 8A-14
C
F
2 BLK 1850
G206
2 BLK 1850
G204
1 BLK 1850
Ground Distribution 8A-14
0.5 BLK/WHT 451
Hot At All Times
IP Fuse Block
D8
A
CIGAR LTR Fuse 2 15 A
B
Power Distribution 8A-10
E7
0.5 ORN 640
B9
C203
0.5 ORN 640
5 ORN 640
Power Distribution 8A-10
Body Bussed Electrical Center (BBEC)
B5
0.5 BLK/WHT 451
P100
C1
E8
Underhood Bussed Electrical Center (UBEC)
Ground Distribution 8A-14
C2
E7
0.8 BLK/WHT 451
Ground Distribution 8A-14
S152
2 BLK/WHT 451
G105

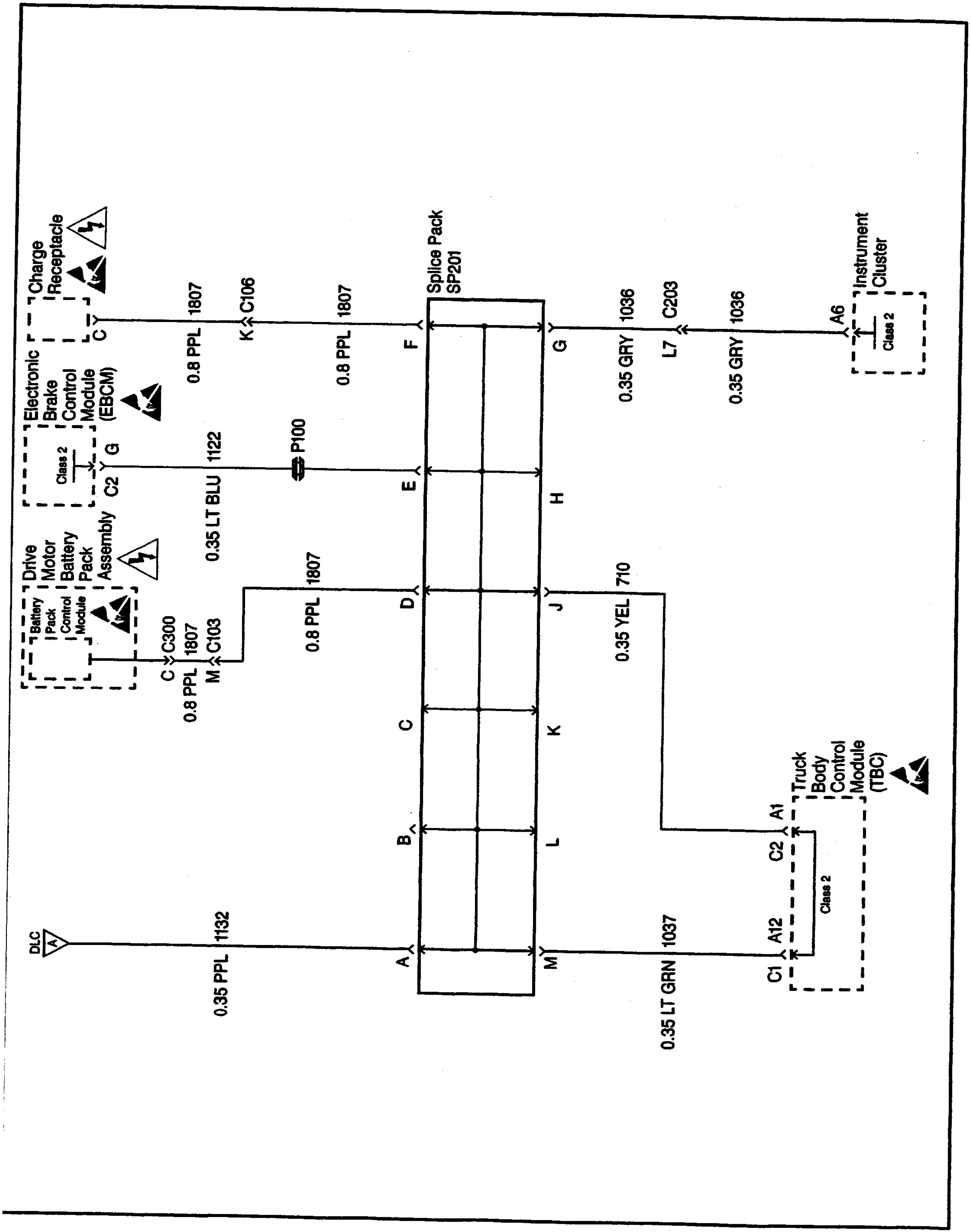
5308w2464

Wiring Diagram - (12 of 15)


Supplemental Restraint Diagnostic Energy Reserve Module
S
0.35 TAN 800
DLC
8
0.35 TAN 800
HTCM
C2
D7
0.35 TAN 800
D6
0.35 TAN 800
Power Inverter Module
C1
22
0.35 TAN 800
C105
P
0.35 TAN 800
23
0.5 TAN 800
C106
G
0.35 TAN 800
Drive Motor Battery Assembly
Battery Pack Control Module
C300
A
0.35 TAN 800
C103
K
0.35 TAN 800
B
0.35 TAN 800
N
0.35 TAN 800
S114

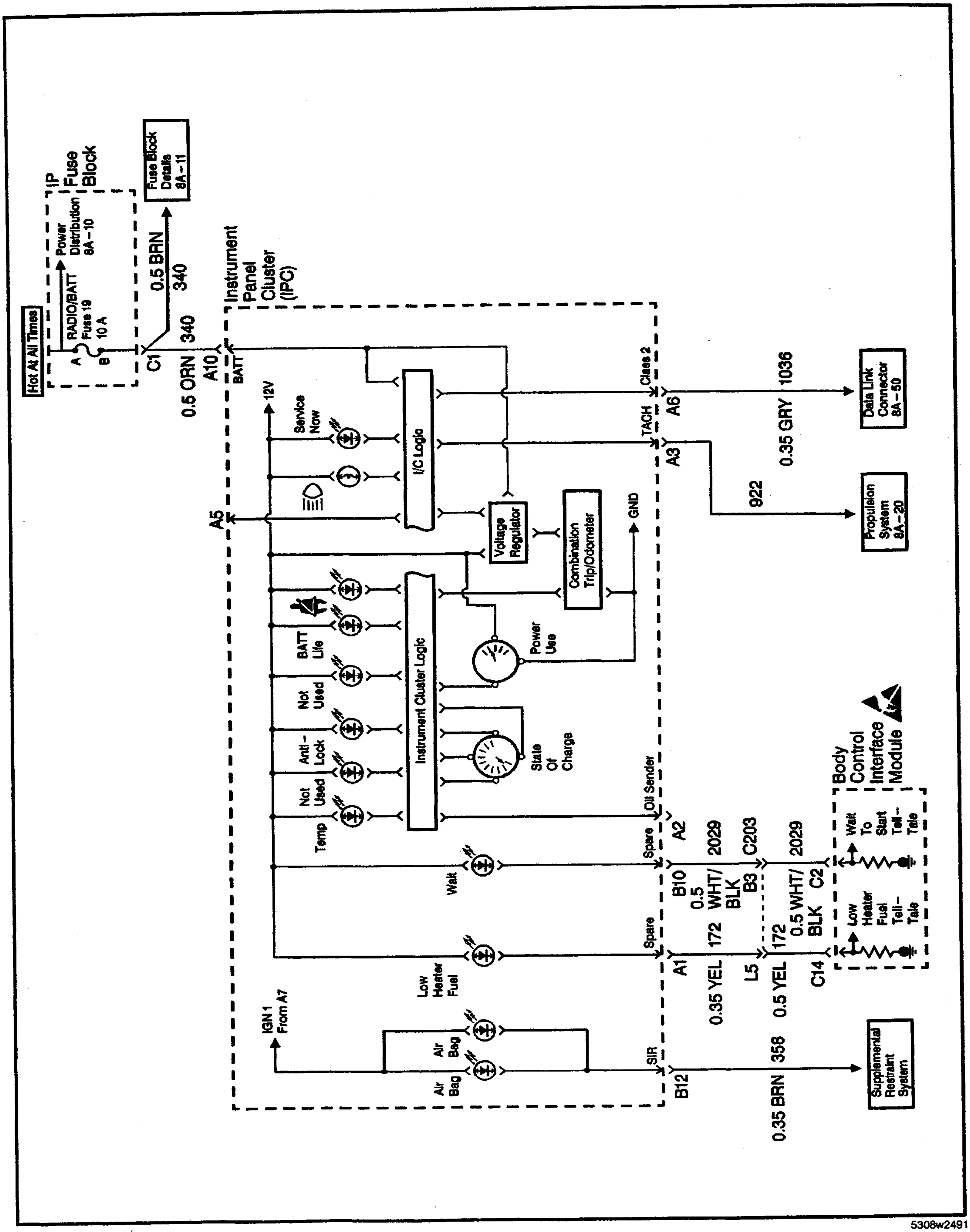
5308w2466

Wiring Diagram - (13 of 15)


Charge Receptacle
C
0.8 PPL 1807
K C106
0.8 PPL 1807
F
Splice Pack SP201
G
0.35 GRY 1036
L7 C203
0.35 GRY 1036
A6
Instrument Cluster
Class 2
Electronic Brake Control Module (EBCM)
Class 2
C2 G
0.35 LT BLU 1122
P100
E
H
Drive Motor Battery Pack Assembly
Battery Pack Control Module
C C300
0.8 PPL 1807
M C103
0.8 PPL 1807
D
J
0.35 YEL 710
C
K
Truck Body Control Module (TBC)
A1
C2
Class 2
B
L
A12
C1
DLC A
0.35 PPL 1132
A
M
0.35 LT GRN 1037

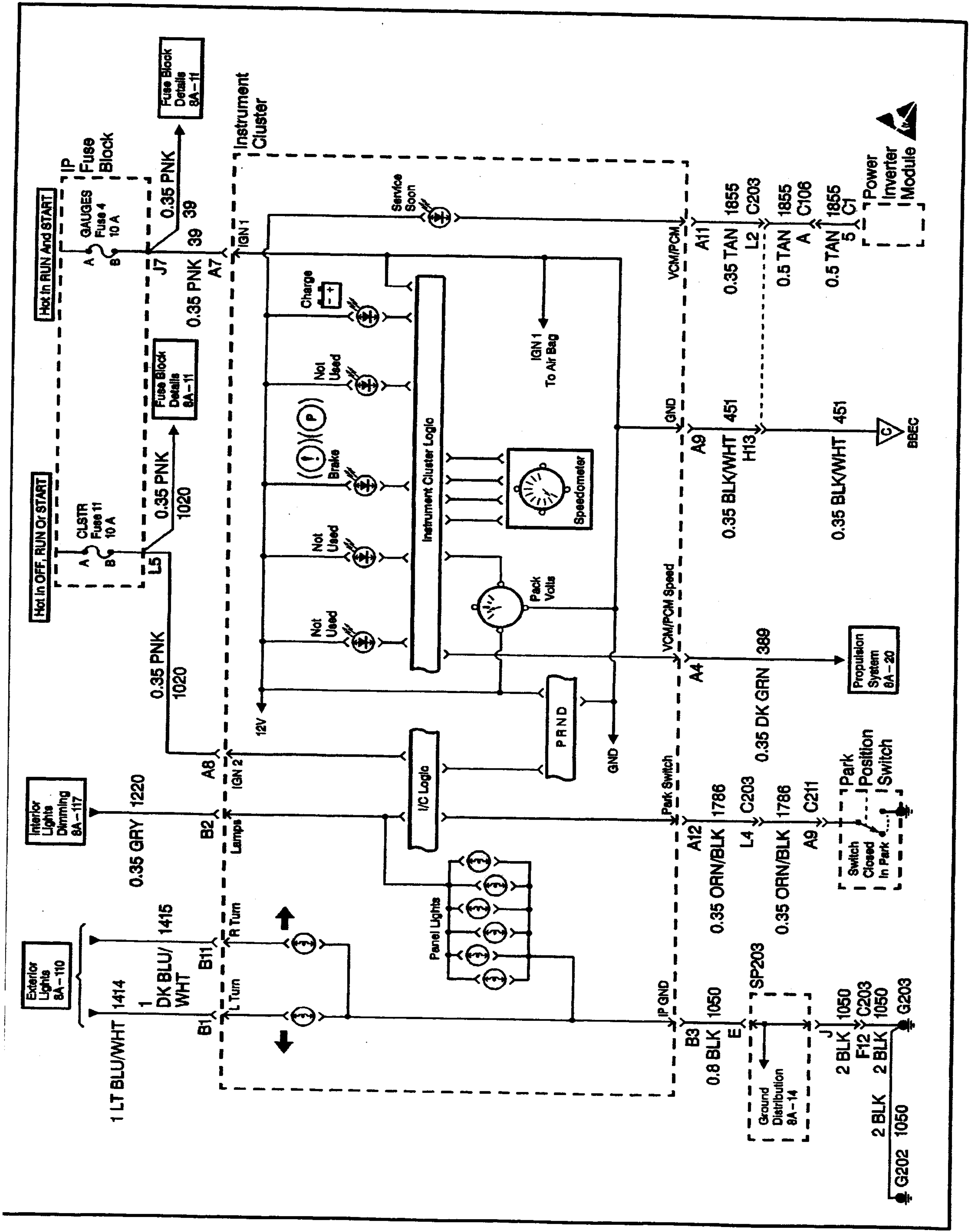
5308w2465

Wiring Diagram - (14 of 15)

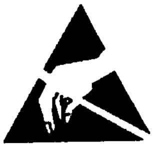
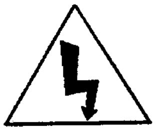

Hot At All Times
IP Fuse Block
A
RADIO/BATT
Fuse 19
10 A
B
Power Distribution 8A-10
Fuse Block Details 8A-11
0.5 BRN
340
C1
340
0.5 ORN
A10
BATT
Instrument Panel Cluster (IPC)
12V
Service Now
I/C Logic
A5
Voltage Regulator
Combination Trip/Odometer
GND
Power Use
BATT Life
Not Used
Anti-Lock
Not Used
Temp
Instrument Cluster Logic
State Of Charge
Oil Sender
Class 2
A6
1036
0.35 GRY
Data Link Connector 8A-50
TACH
A3
922
Propulsion System 8A-20
Body Control Interface Module
Wait To Start Tell-Tale
Low Heater Fuel Tell-Tale
Spare
A2
2029
C203
2029
Wait
Spare
B10
0.5 WHT/BLK
B3
0.5 WHT/BLK
C2
A1
172
L5
172
C14
0.35 YEL
0.5 YEL
Low Heater Fuel
IGN1 From A7
Air Bag
Air Bag
SIR
B12
358
0.35 BRN
Supplemental Restraint System

5308w2491

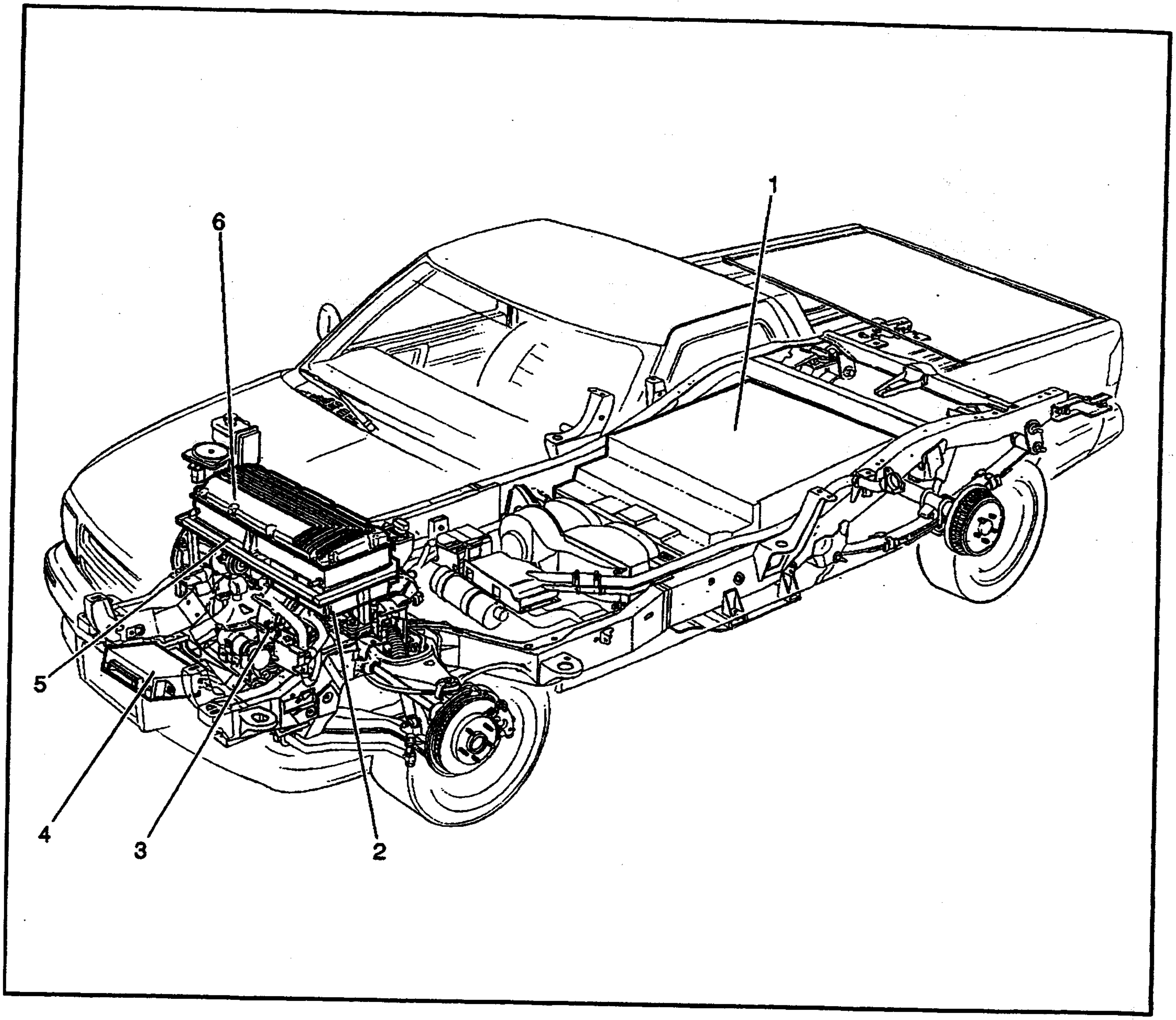
Wiring Diagram - (15 of 15)


Hot In RUN And START
IP Fuse Block
GAUGES Fuse 4 10 A
A
B
J7
0.35 PNK
39
A7
Fuse Block Details 8A-11
Hot In OFF, RUN Or START
CLSTR Fuse 11 10 A
L5
1020
A8
Interior Lights Dimming 8A-117
0.35 GRY
1220
B2
Exterior Lights 8A-110
1 LT BLU/WHT
1414
1 DK BLU/WHT
1415
B1
B11
Instrument Cluster
IGN 1
IGN 2
Lamps
R Turn
L Turn
12V
GND
Service Soon
Charge
Not Used
Brake
Instrument Cluster Logic
Speedometer
Pack Volts
IGN 1 To Air Bag
PRND
I/C Logic
Panel Lights
VCM/PCM
VCM/PCM Speed
Park Switch
IP GND
A11
0.35 TAN
1855
L2
C203
0.5 TAN
A
C106
5
C1
Power Inverter Module
A9
0.35 BLK/WHT
451
H13
BBEC
A4
0.35 DK GRN
389
Propulsion System 6A-20
A12
0.35 ORN/BLK
1786
L4
C211
Park Position Switch
Switch Closed In Park
B3
0.8 BLK
1050
E
SP203
Ground Distribution 8A-14
J
2 BLK
F12
G203
G202

Schematic Icon Reference Table

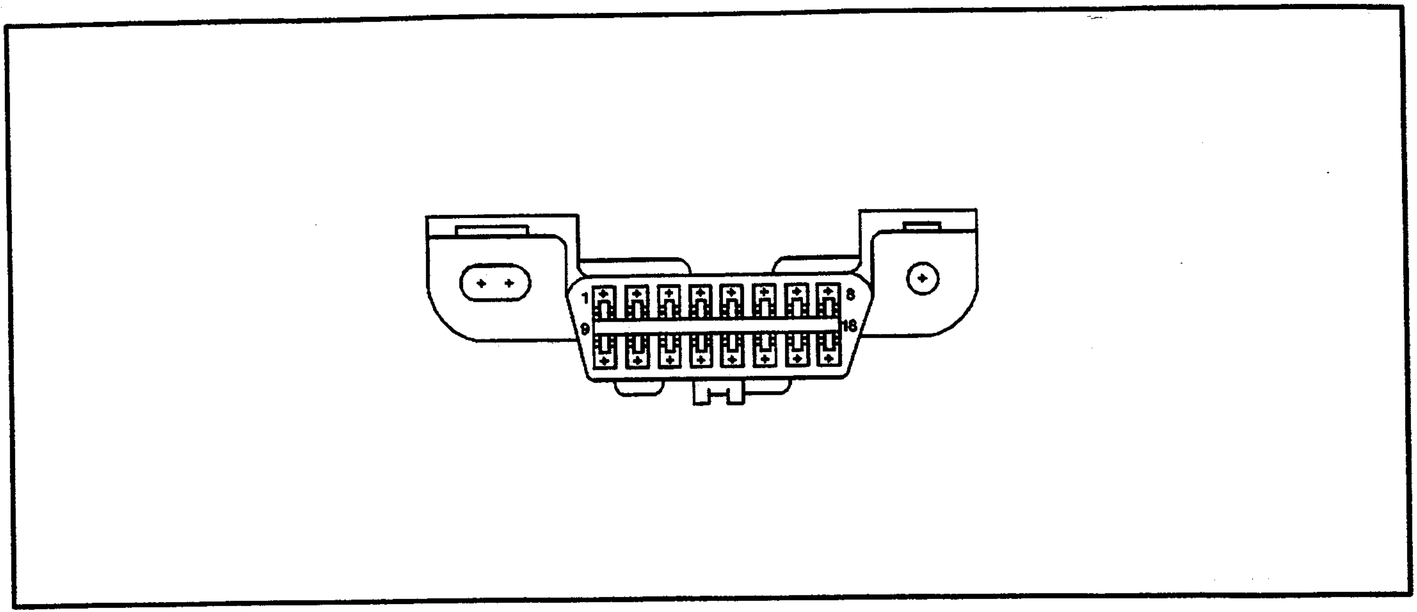
Icon	Icon Definition
	Refer to Electrostatic Discharge (ESD) Sensitive Devices in Symbols, Page 8A – 3 – 0.
	This Icon is used to alert the technician. The circuits shown with this icon on the schematic contain high voltage. Refer to the *High Voltage Power System* caution in *General Information*.

Component Locations



Legend

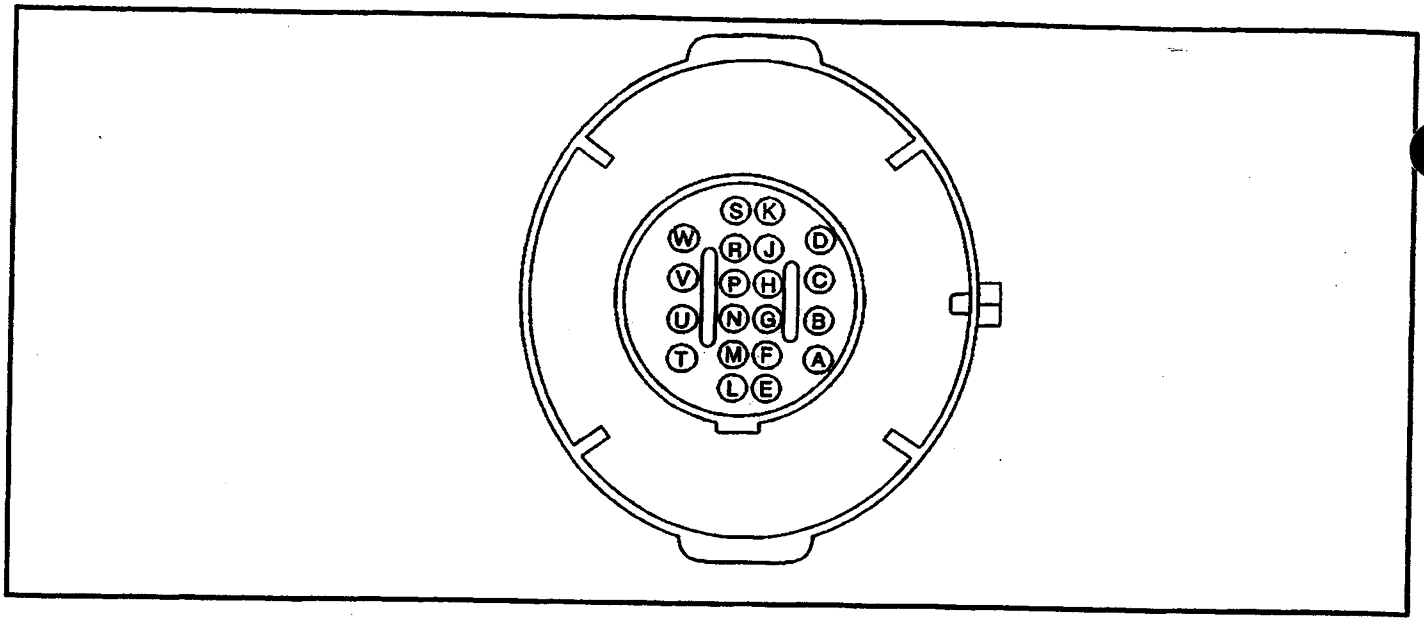
1. Battery Pack
2. Accessory Power Control Module
3. Drive Motor
4. Charge Receptacle
5. Power Steering Control Module
6. Power Inverter Module



470815132

Data Link GRAY Connector Terminal End View

Pin	Function	CKT No.	Color	Refer To
1	Not Used	—	—	—
2	Serial Data Signal-Class B-10400 Baud-Primary	1132	PPL	Electrical Diagnosis
3	Not Used	—	—	—
4	Ground	1850	BLK	Electrical Diagnosis
5	Ground-Clean	451	BLK/WHT	Electrical Diagnosis
6	Not Used	—	—	—
7	Not Used	—	—	—
8	Not Used	—	—	—
9	Serial Data Signal-UART-8192 Baud-Primary	800	TAN	Electrical Diagnosis
10	Not Used	—	—	—
11	Not Used	—	—	—
12	Not Used	—	—	—
13	Not Used	—	—	—
14	Not Used	—	—	—
15	Not Used	—	—	—
16	Fuse Output-Battery	640	ORN	Electrical Diagnosis
(*) For more information refer to *Typical Scan Data Values* within this section.				

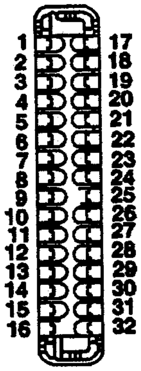


5308v7446

Battery Pack 20-Way In-line GRAY Connector Terminal End View

Pin	Function	CKT No.	Color	Refer To
A	Serial Data Signal-UART-8192 Baud-Primary	800	TAN	Electrical Diagnosis
B	Serial Data Signal-UART-8192 Baud-Primary	800	TAN	Electrical Diagnosis
C	Serial Data Signal-Class B-10400 Baud-Primary	1807	PPL	Electrical Diagnosis
D	Transmission Range Indicator Switch Park Output	275	LT GRN	Electrical Diagnosis
E	Battery Feed	940	ORN	Electrical Diagnosis
F	Ground-Clean	451	BLK/WHT	Electrical Diagnosis
G	Battery Air Flow Sensor Signal	492	YEL	Electrical Diagnosis
H	Battery Air Flow Sensor Return	645	RED/BLK	Electrical Diagnosis
J	Not Used	—	—	—
K	Not Used	—	—	—
L	Charge Receptacle Temperature 5 Volt Reference	5646	WHT	Electrical Diagnosis
M	Charge Receptacle Temperature Return	660	DK BLU	Electrical Diagnosis
N	Not Used	—	—	—
P	Not Used	—	—	—
R	Fuse Output-Ignition 1 Type III Fuse	1020	PNK	Electrical Diagnosis
S	Vehicle Wake Up	2027	WHT	Electrical Diagnosis
T	High Voltage Disconnect In	951	RED/WHT	Electrical Diagnosis
U	High Voltage Disconnect Out	960	RED	Electrical Diagnosis
V	High Voltage Disconnect	931	BLK/WHT	Electrical Diagnosis
W	Power Use Signal	915	YEL	Electrical Diagnosis

(*) For more information refer to *Typical Scan Data Values* within this section.

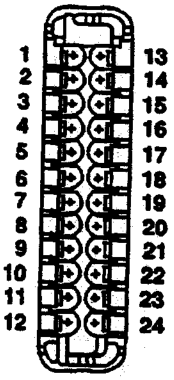


qt0668a202

Power Inverter Module 32-way CLEAR Connector Terminal End View C1

Pin	Function	CKT No.	Color	Refer To
C1-1	Ground-DMCM	451	BLK/WHT	Electrical Diagnosis
C1-2	Not Used	—	—	—
C1-3	Not Used	—	—	—
C1-4	Vehicle Speed Signal-4000 Pulses Per Mile	817	DK GRN/WHT	Electrical Diagnosis
C1-5	Service Soon Tell-Tale	1855	TAN	Electrical Diagnosis
C1-6	Not Used	—	—	—
C1-7	Stoplamp Switch Signal	1054	ORN	Electrical Diagnosis
C1-8	Charge Tell-Tale Input	2023	DK GRN	Electrical Diagnosis
C1-9	Cruise Control Set/Coast Switch Signal	84	DK BLU	Electrical Diagnosis
C1-10	Cruise Control On Switch Output	397	GRY	Electrical Diagnosis
C1-11	Not Used	—	—	—
C1-12	APP3 Signal	968	LT GRN	Electrical Diagnosis
C1-13	APP2 Signal	965	PNK	Electrical Diagnosis
C1-14	APP1 Signal	962	TAN	Electrical Diagnosis
C1-15	APP3 5 Volt Reference	969	DK GRN	Electrical Diagnosis
C1-16	APP2 5 Volt Reference	966	PPL	Electrical Diagnosis
C1-17	Ground-PSCM	451	BLK/WHT	Electrical Diagnosis
C1-18	Not Used	—	—	—
C1-19	Fuse Output-Ignition 1-Type III Fuse	1020	PNK	Electrical Diagnosis
C1-20	Fuse Output-Battery-Type III Fuse	1040	ORN	Electrical Diagnosis
C1-21	Not Used	—	—	—
C1-22	Serial Data Signal-Uart-8192 Baud-Primary	800	TAN	Electrical Diagnosis
C1-23	Serial Data Signal-Uart-8192 Baud-Primary	800	TAN	Electrical Diagnosis
C1-24	Brake Pedal Switch Output	420	PPL	Electrical Diagnosis
C1-25	Cruise Control Resume/Accel Switch Signal	87	GRY	Electrical Diagnosis
C1-26	Run 2 Relay	241	BRN	Electrical Diagnosis
C1-27	Not Used	—	—	—
C1-28	APP3 Sensor Ground	967	RED	Electrical Diagnosis
C1-29	APP2 Sensor Ground	964	BLK	Electrical Diagnosis
C1-30	APP1 Sensor Ground	963	WHT	Electrical Diagnosis
C1-31	APP1 5 Volt Reference	961	YEL	Electrical Diagnosis
C1-32	Not Used	—	—	—

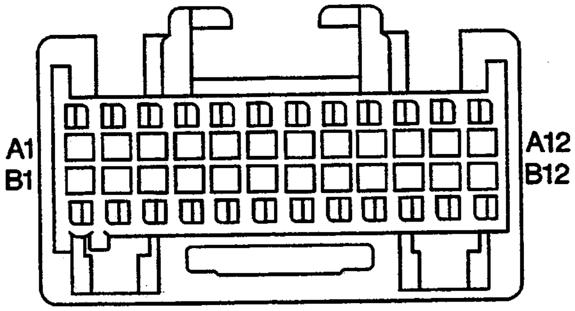
(*) For more information refer to *Typical Scan Data Values* within this section.



qt0978a202

Power Inverter Module 24-way CLEAR Connector Terminal End View C2

Pin	Function	CKT No.	Color	Refer To
C2-1	Not Used	—	—	—
C2-2	Not Used	—	—	—
C2-3	Not Used	—	—	—
C2-4	Motor Winding Temperature Sensor Signal Return	1798	PNK	Electrical Diagnosis
C2-5	Motor Winding Temperature Sensor Signal	37	DRK GRN	Electrical Diagnosis
C2-6	Transmission Range Indicator Switch Return	470	BLK	Electrical Diagnosis
C2-7	Transmission Range Indicator Switch Parity Bit Input	776	WHT	Electrical Diagnosis
C2-8	Transmission Range Indicator Switch Bit "C" Output	773	GRY	Electrical Diagnosis
C2-9	Transmission Range Indicator Switch Bit "B" Output	772	YEL	Electrical Diagnosis
C2-10	Transmission Range Indicator Switch Bit "A" Output	771	BLK/WHT	Electrical Diagnosis
C2-11	Not Used	—	—	—
C2-12	Not Used	—	—	—
C2-13	Drive Motor Speed and Direction Sensor Signal Power-12 Volt Reference	1673	RED	Electrical Diagnosis
C2-14	Drive Motor Speed and Direction Sensor Signal "A"	1557	DK BLU/WHT	Electrical Diagnosis
C2-15	Drive Motor Speed and Direction Sensor Signal "B"	1558	YEL/BLK	Electrical Diagnosis
C2-16	Drive Motor Speed and Direction Sensor Signal Ground - Return	552	BLK	Electrical Diagnosis
C2-17	Shield Drain Wire	514	BARE	Electrical Diagnosis
C2-18	Not Used	—	—	—
C2-19	Not Used	—	—	—
C2-20	Not Used	—	—	—
C2-21	Not Used	—	—	—
C2-22	Not Used	—	—	—
C2-23	Not Used	—	—	—
C2-24	Not Used	—	—	—
(*) For more information refer to *Typical Scan Data Values* within this section.				



4108v5583

Body Control Interface Module 32-way BLUE Connector Terminal End View C2

Pin	Function	CKT No.	Color	Refer To
C1	Fuse Output, Unlock,Run, Crank, - Type III Fuse	1020	PNK	Electrical Diagnosis
C2	Wait Tell Tale	2029	WHT/BLK	Electrical Diagnosis
C3	Run 2 Relay	541	BRN	Electrical Diagnosis
C4	Stoplamp Switch Input	17	WHT	Electrical Diagnosis
C5	State Of Charge Gauge Signal	915	YEL	Electrical Diagnosis
C6	State Of Charge Gauge Output	922	PPL	Electrical Diagnosis
C7	Fuel Fired Heater Relay Request	903	WHT	Electrical Diagnosis
C8	Not used	—	—	—
C9	Low Heater Fuel Tell Tale Input	30	PPL	Electrical Diagnosis
C10	Fuse Output, Unlock, Run, Crank - Type III Fuse	1020	PNK	Electrical Diagnosis
C11	Vehicle Wake Up	2027	WHT	Electrical Diagnosis
C12	Fuel Fired Heater Relay	913	TAN	Electrical Diagnosis
C13	Not Used	—	—	—
C14	Low Heater Fuel Tell Tale	172	YEL	Electrical Diagnosis
C15	Fuse Output- Battery-Type III Fuse	1740	ORN	Electrical Diagnosis
C16	Accessory Power Module Output Command	5620	ORN	Electrical Diagnosis
D1	Run 2 Relay Request	819	TAN	Electrical Diagnosis
D2	Stoplamp Switch Signal	1054	ORN	Electrical Diagnosis
D3	Battery Air Flow Sensor Signal	492	YEL	Electrical Diagnosis
D4	Battery Air Flow Sensor Return	645	RED/BLK	Electrical Diagnosis
D5	Ground	451	BLK/WHT	Electrical Diagnosis
D6	Secondary Battery Valve Request	1395	LT GRN	Electrical Diagnosis
D7	RT. Rear Wheel Speed High	882	BRN	Electrical Diagnosis
D8	LT. Rear Wheel Speed Low	885	RED	Electrical Diagnosis
D9	RT. Rear Wheel Speed Low	883	WHT	Electrical Diagnosis
D10	LT. Rear Wheel Speed High	884	BLK	Electrical Diagnosis
D11	Battery Fan	5650	PPL	Electrical Diagnosis
D12	Battery Fan Request	268	YEL	Electrical Diagnosis
D13	Secondary Battery Valve	1397	PPL	Electrical Diagnosis
D14	Battery Pack Valve Primary	2901	BLK	Electrical Diagnosis
D15	Primary Battery Valve Relay Control	901	DK BLU	Electrical Diagnosis
D16	Rear Wheel Speed Signal	1827	YEL/BLK	Electrical Diagnosis

(*) For more information refer to *Typical Scan Data Values* within this section.

High Voltage Safety

Caution: DC and AC high voltage. To help avoid injury, always follow the service manual procedures and manually disconnect the high voltage system before working on or around it.

High Voltage Power System Caution

Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled.

The S-10 Electric has both high voltage DC and AC systems, as well as a 12-volt system. DC and AC high voltage are both very dangerous and can cause severe burns and shock. You first need training about how to repair the S-10 Electric and then must follow the proper repair procedures to minimize the risk.

Currents as low as .05 ma AC or 2 ma DC can cause injuries under some conditions. The potential for injury depends on the current path through the body, the amount of current, and how long the current flows through the body. Other factors that influence the effect of current are the body's impedance, the frequency of the current, the moisture level of the skin, the size of the contact area, the pressure exerted, temperature, and the physiological characteristics of the individual.

AC and DC high voltage affect the body differently. The varying current with AC high voltage is more traumatic to the body and can also prevent letting go of the electrodes.

The high voltage system is independent and isolated from the 12-volt system. when a fault is detected, the high voltage system is automatically disconnected. The is also a manual high voltage disconnect that must be used before service work is performed on or around the high voltage system. Refer to *High voltage disable procedure.*

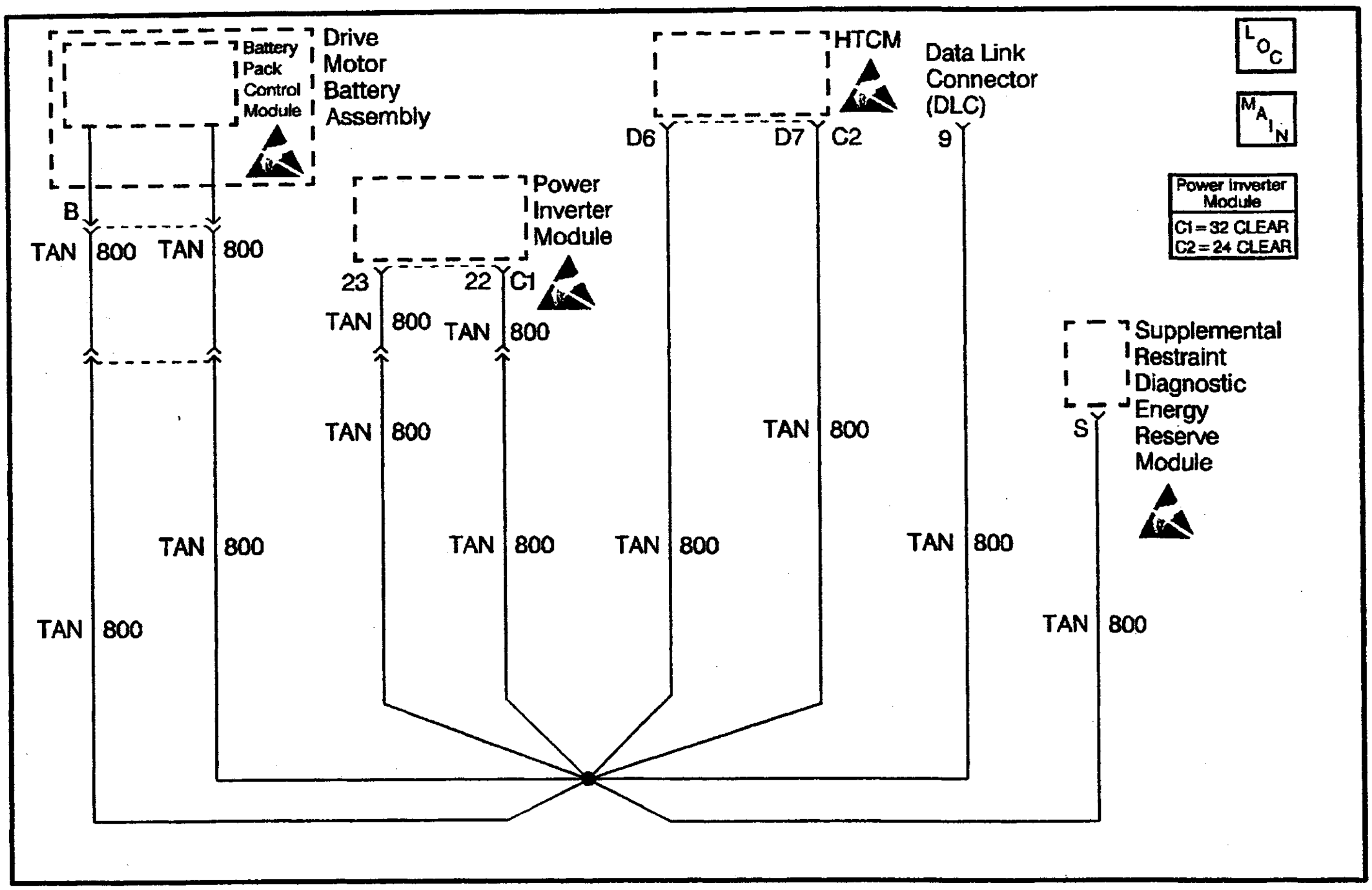
To help avoid injury:

- Do not work on the S-10 Electric without training. Even the greatest gasoline engine technician needs training for this vehicle.
- Follow the service manual procedures and cautions.
- ALWAYS assume that high voltage is present.
- To prevent current from having a path through your body, use one hand to do an operation on the high voltage system.
- Use electrical tape to cover all metal parts of your tools to reduce the chance that the tools will complete a current path.

Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled

Caution: The battery pack has at least 25 times the energy of one regular automotive battery. Extra precautions should be taken when the battery pack is removed from the truck because the automatic disconnect cannot protect you from a disconnected battery pack. Follow the service manual procedures and cautions.

OBD System Check


Battery Pack Control Module
Drive Motor Battery Assembly
B
TAN 800
TAN 800
Power Inverter Module
23
22
C1
HTCM
D6
D7
C2
Data Link Connector (DLC)
9
LOC
MAIN
Power Inverter Module
C1=32 CLEAR
C2=24 CLEAR
Supplemental Restraint Diagnostic Energy Reserve Module
S
TAN 800
264084

System Description

The on-board diagnostic system check is an organized approach in order to identify a problem created by a control module system malfunction. The on-board diagnostic system check must be the starting point for any driveability or cruise control complaint diagnosis. The on-board diagnostic system check will direct you to the next logical step in diagnosing the complaint. Understanding the chart and using it correctly will reduce diagnostic time and prevent unnecessary replacement of good parts.

Diagnostic Aids

Check for the following conditions:

- Check for loose or damaged connectors at the controller, instrument cluster, and the Body Control Interface Module.

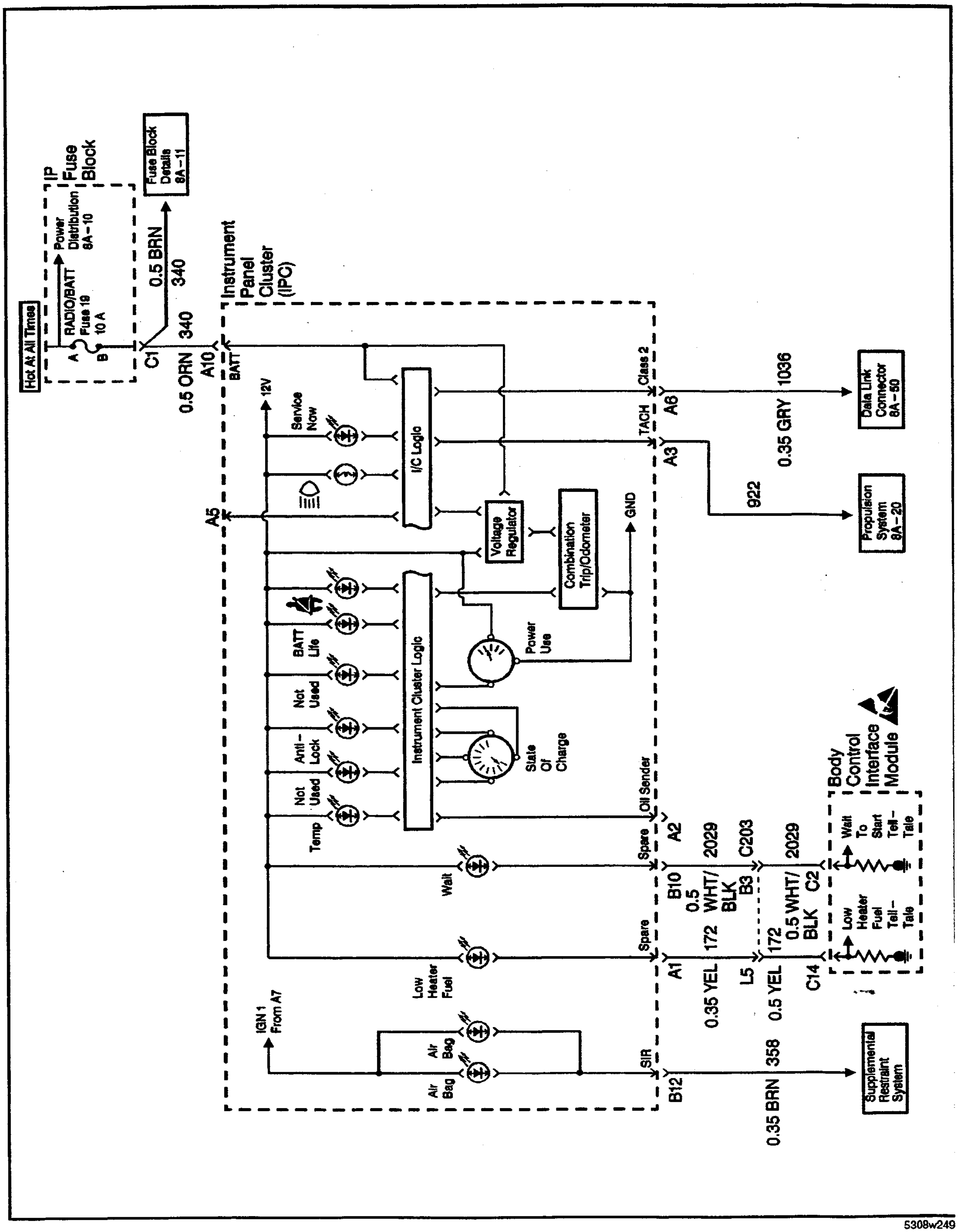
Test Description

1. This step checks lamp function.
4. This step checks serial data communications.
6. This step checks for diagnostic trouble codes.

OBD System Check

Step	Action	Value(s)	Yes	No
1	1. Turn the key to the RUN position. 2. Observe the SERVICE NOW indicator lamp. Is the SERVICE NOW indicator lamp ON during bulb check?	—	Go to Step 2	Go to *No SERVICE NOW Indicator Lamp* table
2	Observe the SERVICE SOON indicator lamp. Was the SERVICE SOON indicator lamp ON during bulb check?	—	Go to Step 3	Go to *No SERVICE SOON Indicator Lamp* table
3	Observe the BATT LIFE indicator lamp. Was the BATT LIFE indicator lamp ON during bulb check?	—	Go to Step 4	Go to *No BATT LIFE Indicator Lamp* table
4	Connect the scan tool. Does the scan tool display serial data from the Drive Motor Control Module, Battery Pack Control Module, and the HTCM?	—	Go to Step 5	Go to *No Serial Data* table
5	Does the scan tool display Class 2 data from the Instrument Panel Cluster?	—	Go to Step 6	Refer to section 8C1
6	Check for any stored DTCs. Are there any DTCs stored in memory?	—	Go to the appropriate DTC table	Go to Step 7
7	Is either the SERVICE SOON, SERVICE NOW, or BATT LIFE lamp ON continuously with no DTCs?		Go to *Indicator Lamp Always ON* table	Go to Step 8
8	Compare vehicle scan data with typical scan data values. Are vehicle scan data values within typical ranges?	—	Go to Step 9	Go to the diagnostic check for that component
9	For propulsion driveability symptoms refer to a specific driveability symptom diagnostic table.	—	—	—

Indicator Lamp always ON


Hot At All Times
IP Fuse Block
RADIO/BATT Fuse 19 10 A
A
B
Power Distribution 8A-10
C1
0.5 ORN
340
A10
0.5 BRN
340
Fuse Block Details 8A-11
Instrument Panel Cluster (IPC)
BATT
12V
Service Now
I/C Logic
Class 2
A6
0.35 GRY
1036
Data Link Connector 8A-50
TACH
A3
922
Propulsion System 8A-20
A5
Voltage Regulator
Combination Trip/Odometer
GND
Power Use
BATT Life
Not Used
Anti-Lock
Not Used
Temp
Instrument Cluster Logic
State Of Charge
Oil Sender
A2
Spare
Wait
B10
0.5 WHT/BLK
2029
C203
B3
0.5 WHT/BLK
2029
C2
Spare
A1
0.35 YEL
172
L5
0.5 YEL
172
C14
Low Heater Fuel
Body Control Interface Module
Wait To Start Tell-Tale
Low Heater Fuel Tell-Tale
IGN 1 From A7
Air Bag
Air Bag
SIR
B12
0.35 BRN
358
Supplemental Restraint System

5308w249

Circuit Description

There should always be a steady SERVICE SOON, SERVICE NOW and BATT LIFE lamp for 3 to 5 seconds when the ignition is ON during a bulb check. Battery voltage is supplied to the lamp(s) through the instrument cluster. The Power Inverter Module supplies a ground signal to the Instrument Panel Cluster to illuminate the SERVICE SOON lamp. The SERVICE NOW and BATT LIFE lamps are illuminated by the Instrument Panel Cluster which is a Class 2 controlled device.

Diagnostic Aids

Check for the following conditions:

- Check for loose or damaged connectors at the Power Inverter Module, Instrument Panel Cluster, and the Body Control Interface Module.
- Check for short to ground before the control module that controls the lamp in question.

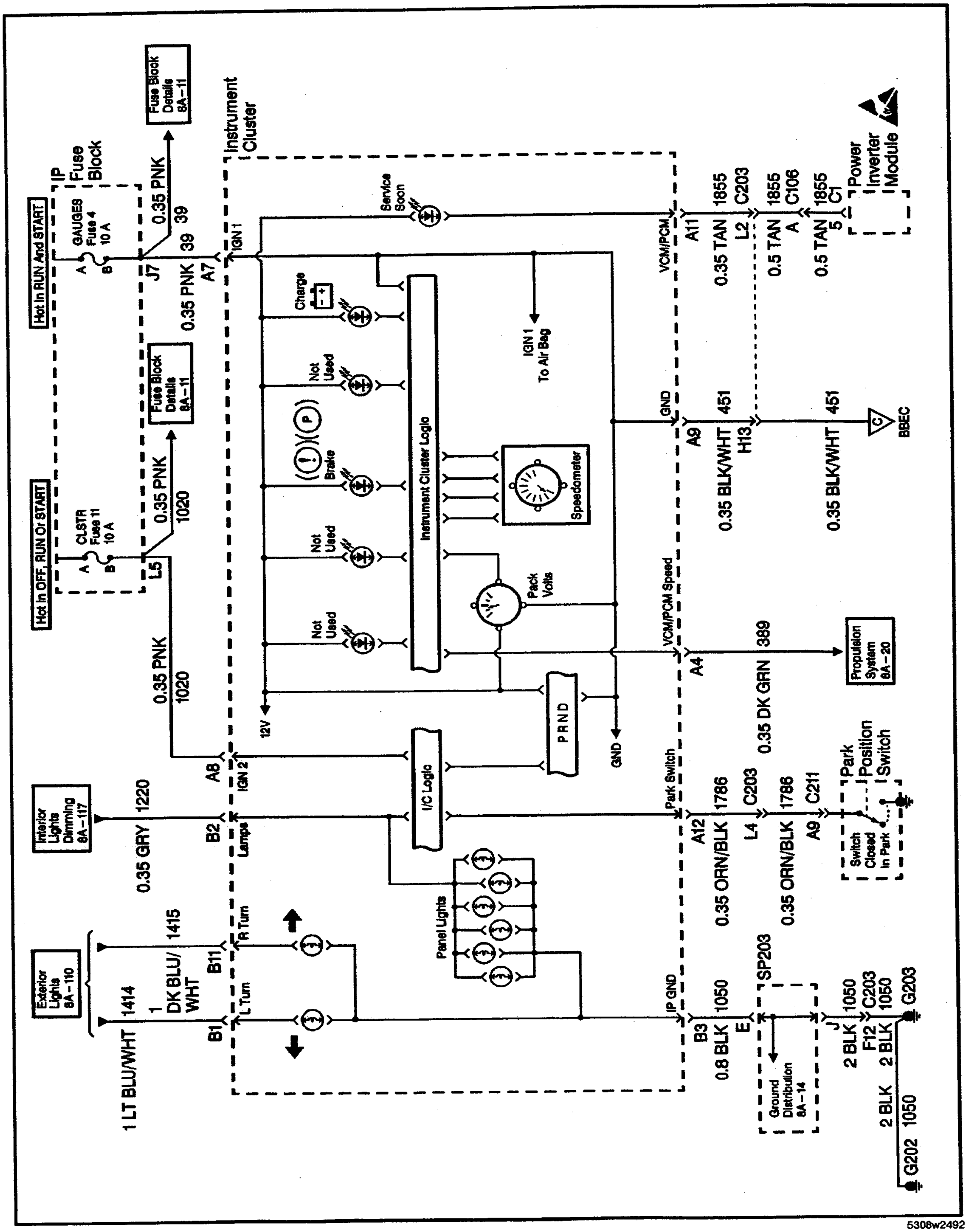
Test Description

2. Check to see if the fault is present.
3. Check to see if the fault is present.
4. Checks for a short to ground before the Power Inverter Module 32-way.
5. Checks for a short to ground between the Power Inverter Module and the Instrument Panel Cluster.

Indicator Lamp Always ON

Step	Action	Value(s)	Yes	No
1	Were you sent here from the On-Board Diagnostic (OBD) System Check?	—	Go to Step 2	Go to *OBD System Check*
2	Is the SERVICE SOON lamp always ON?		Go to Step 4	Go to Step 3
3	Is the BATT LIFE or SERVICE NOW Indicator Lamp always ON?		Refer to section 8C1	Go to *OBD System Check*
4	1. Turn OFF the ignition switch. 2. Disconnect the Power Inverter Module 32-way connector. 3. Turn ON the ignition switch. Does the SERVICE SOON indicator lamp go OFF?	—	Go to Step 8	Go to Step 5
5	Check for short to ground in control circuit between the Power Inverter Module and the Instrument Panel Cluster. Was a problem Found?	—	Go to Step 7	Go to Step 6
6	Replace the I/P cluster. Refer to section 8C1 Is the repair complete?	—	Go to *OBD System Check*	—
7	Repair the wiring harness as required. Refer to *Wiring Repairs* in *Wiring Systems.* Is the repair complete?	—	Go to *OBD System Check*	—
8	Replace the Drive Motor Control Module. Refer To *Power Inverter Module Assembly Removal and Installation.* Is the repair complete?	—	Go to *OBD System Check*	—

No SERVICE SOON Indicator Lamp


Hot In RUN And START
IP Fuse Block
GAUGES Fuse 4 10 A
Fuse Block Details 8A-11
0.35 PNK
39
J7
A7
Hot In OFF, RUN Or START
CLSTR Fuse 11 10 A
L5
1020
Instrument Cluster
IGN 1
IGN 2
Service Soon
Charge
Not Used
Brake
Not Used
Not Used
Instrument Cluster Logic
Speedometer
Pack Volts
PRND
12V
GND
IGN 1 To Air Bag
I/C Logic
Panel Lights
Lamps
R Turn
L Turn
VCM/PCM
A11
1855
0.35 TAN
L2
C203
0.5 TAN
A
C106
5
C1
Power Inverter Module
GND
A9
451
0.35 BLK/WHT
H13
BBEC
VCM/PCM Speed
A4
389
0.35 DK GRN
Propulsion System 8A-20
Park Switch
A12
1786
0.35 ORN/BLK
L4
C211
Park Position Switch
Switch Closed In Park
A8
Interior Lights Dimming 8A-117
B2
1220
0.35 GRY
Exterior Lights 8A-110
1414
1 LT BLU/WHT
1415
1 DK BLU/WHT
B11
B1
IP GND
B3
1050
0.8 BLK
E
SP203
Ground Distribution 8A-14
J
2 BLK
F12
G203
G202

5308w2492

Circuit Description

There should always be a steady SERVICE SOON lamp for 3 to 5 seconds when the ignition is on during a bulb check. Battery voltage is supplied to the lamp through the instrument cluster. The Drive Motor Control Module is located inside the Power Inverter Module and supplies a ground signal through circuit 1855 to the Instrument Cluster.

Diagnostic Aids

Check for the following conditions:

- Check for loose or damaged connectors at the C106, C203 and the Drive Motor Control Module.
- Run 1 voltage is supplied to the instrument cluster through the radio/batt. fuse 19.

Test Description

2. Forces the service soon lamp on from the Power Inverter Module.
4. Forces the service soon lamp on from the C106 connector.
6. Forces the service soon lamp on from the C203 connector.

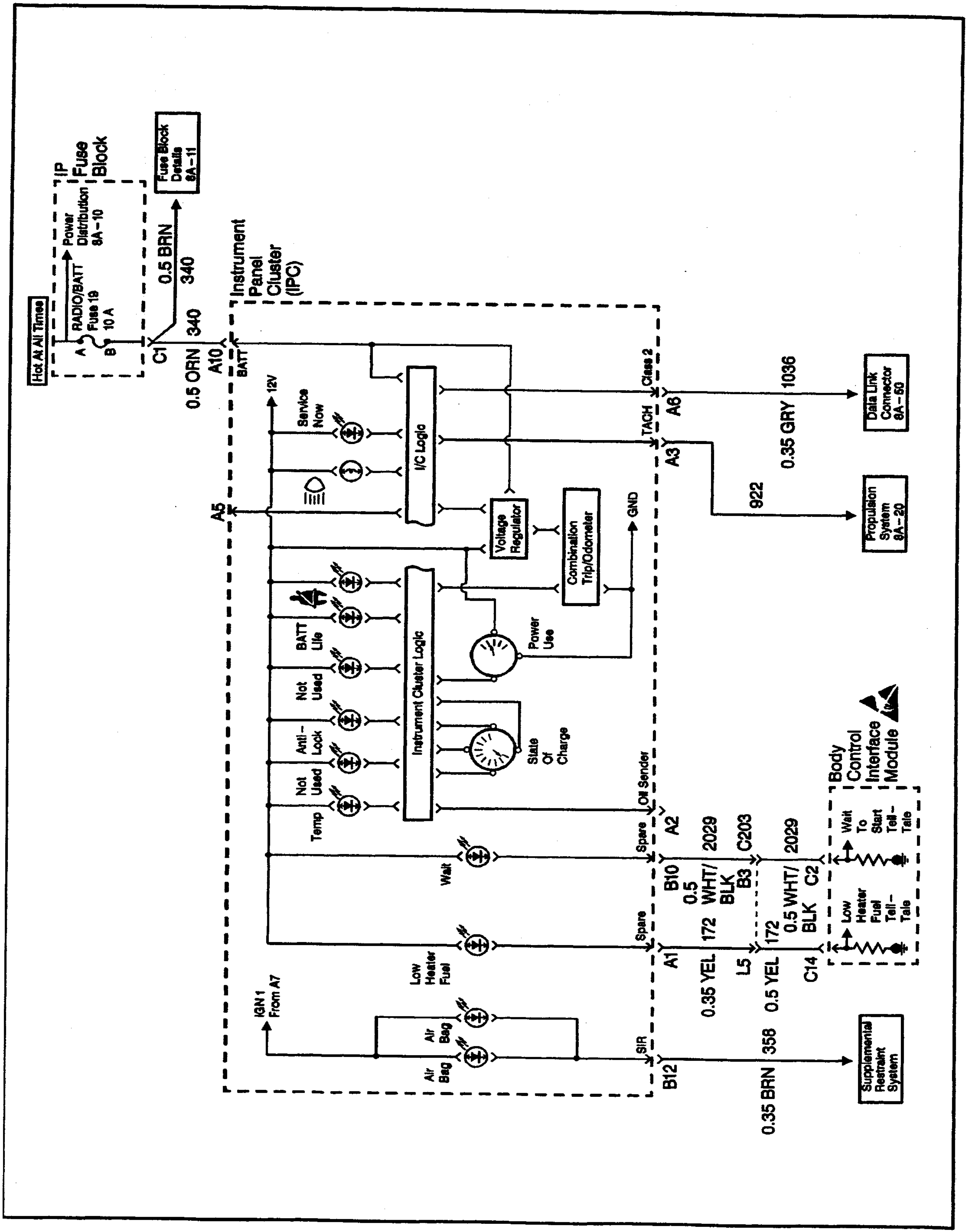
No SERVICE SOON Indicator Lamp

Step	Action	Value(s)	Yes	No
1	Were you sent here from the On-Board Diagnostic (OBD) System Check?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn OFF the ignition switch. 2. Disconnect the Power Inverter Module 32-way connector. 3. Turn ON the ignition switch. 4. Using a fused jumper wire ground circuit 1855 on the 32-way connector. Does the SERVICE SOON indicator lamp turn ON?	—	Go to Step 3	Go to Step 4
3	Check for a poor connection at the Power Inverter Module. Was a poor connection found?	—	Go to Step 10	Go to Step 12
4	1. Disconnect the C106 connector. 2. Using a fused jumper wire apply ground to circuit 1855 to the IP cluster. Does the SERVICE SOON indicator lamp turn ON?	—	Go to Step 5	Go to Step 6
5	Check for continuity on circuit 1855 between the Power Inverter Module and connector C106. Is continuity present?	—	Go to Step 11	Go to Step 10
6	1. Disconnect the C203 connector. 2. Using a fused jumper wire apply ground to circuit 1855 to the IP cluster. Does the SERVICE SOON indicator lamp turn ON?	—	Go to Step 7	Go to Step 8
7	Check for continuity on circuit 1855 between the C106 and connector C203. Is continuity present?	—	Go to Step 11	Go to Step 10
8	Remove the instrument cluster and check for continuity on circuit 1855 between the C203 and the instrument cluster. Is continuity Present	—	Go to Step 9	Go to Step 11

No SERVICE SOON Indicator Lamp (continued)

Step	Action	Value(s)	Yes	No
9	Replace the instrument cluster. Is the repair complete?	—	Go to *OBD System Check*	—
10	Repair the wiring harness as required. Refer to *Wiring Repairs* in *Wiring Systems.* Is the repair complete?	—	Go to *OBD System Check*	—
11	Repair the wiring connection at the Connector as required. Refer to *Wiring Repairs* in *Wiring Systems.* Is the repair complete?	—	Go to *OBD System Check*	—
12	Replace the Drive Motor Control Module. Refer To *Power Inverter Module Assembly Removal and Installation.* Is the repair complete?	—	Go to *OBD System Check*	—

No SERVICE NOW Indicator Lamp


Hot At All Times
RADIO/BATT
Fuse 19
10 A
A
B
Power Distribution 8A-10
IP Fuse Block
Fuse Block Details 8A-11
0.5 BRN
340
C1
340
0.5 ORN
A10
BATT
Instrument Panel Cluster (IPC)
Class 2
A8
1036
0.35 GRY
Data Link Connector 8A-50
TACH
A3
922
Propulsion System 8A-20
I/C Logic
12V
Service Now
A5
Voltage Regulator
Combination Trip/Odometer
GND
Instrument Cluster Logic
Power Use
BATT Life
Not Used
Anti-Lock
Not Used
Temp
State Of Charge
Oil Sender
A2
Spare
Wait
B10
0.5 WHT/BLK
2029
C203
B3
2029
0.5 WHT/BLK
C2
Body Control Interface Module
Wait To Start Tell-Tale
Low Heater Fuel Tell-Tale
Spare
A1
172
0.35 YEL
L5
172
0.5 YEL
C14
Low Heater Fuel
IGN 1 From A7
Air Bag
Air Bag
SIR
B12
358
0.35 BRN
Supplemental Restraint System

5308w2491

Circuit Description

There should always be a steady SERVICE SOON, SERVICE NOW and BATT LIFE lamp for 3 to 5 seconds when the ignition is ON during a bulb check. Battery voltage is supplied to the lamp(s) through the instrument cluster. The Power Inverter Module supplies a ground signal to the Instrument Panel Cluster to illuminate the SERVICE SOON lamp. The SERVICE NOW and BATT LIFE lamps are illuminated by the Instrument Panel Cluster which is a Class 2 controlled device.

Diagnostic Aids

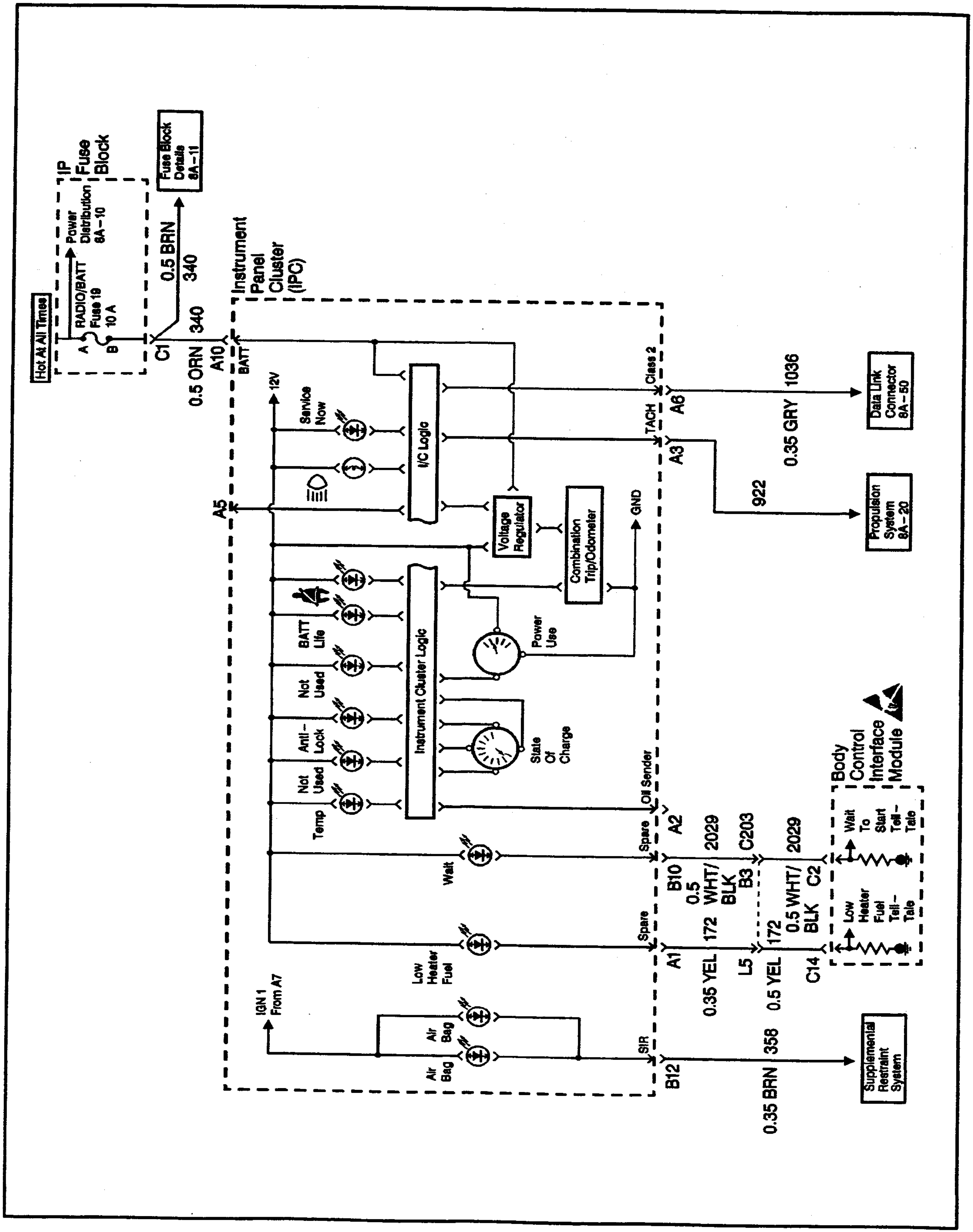
Check for the following conditions:

- Using the special function feature of the scan tool, command the Indicator Lamp ON.

No SERVICE NOW Indicator Lamp

Step	Action	Value(s)	Yes	No
1	Were you sent here from the On-Board Diagnostic (OBD) System Check?	—	Refer to section 8C1	Go to *OBD System Check*

No BATT LIFE Indicator Lamp


Hot At All Times
IP Fuse Block
A
RADIO/BATT
Fuse 19
10 A
B
Power Distribution 8A-10
Fuse Block Details 8A-11
0.5 BRN
340
C1
340
0.5 ORN
A10
BATT
Instrument Panel Cluster (IPC)
12V
Service Now
I/C Logic
A5
Voltage Regulator
Combination Trip/Odometer
GND
BATT Life
Not Used
Anti-Lock
Not Used
Temp
Instrument Cluster Logic
Power Use
State Of Charge
Class 2
A6
1036
0.35 GRY
Data Link Connector 8A-50
TACH
A3
922
Propulsion System 8A-20
Oil Sender
A2
Spare
Wait
B10
0.5
0.5 WHT/BLK
2029
C203
B3
2029
0.5 WHT/BLK
C2
Body Control Interface Module
Wait To Start Tell-Tale
Low Heater Fuel Tell-Tale
Spare
A1
172
0.35 YEL
L5
172
0.5 YEL
C14
Low Heater Fuel
IGN 1 From A7
Air Bag
Air Bag
SIR
B12
358
0.35 BRN
Supplemental Restraint System

5308w2491

Circuit Description

There should always be a steady SERVICE SOON, SERVICE NOW and BATT LIFE lamp for 3 to 5 seconds when the ignition is ON during a bulb check. Battery voltage is supplied to the lamp(s) through the instrument cluster. The Power Inverter Module supplies a ground signal to the Instrument Panel Cluster to illuminate the SERVICE SOON lamp. The SERVICE NOW and BATT LIFE lamps are illuminated by the Instrument Panel Cluster which is a Class 2 controlled device.

Diagnostic Aids

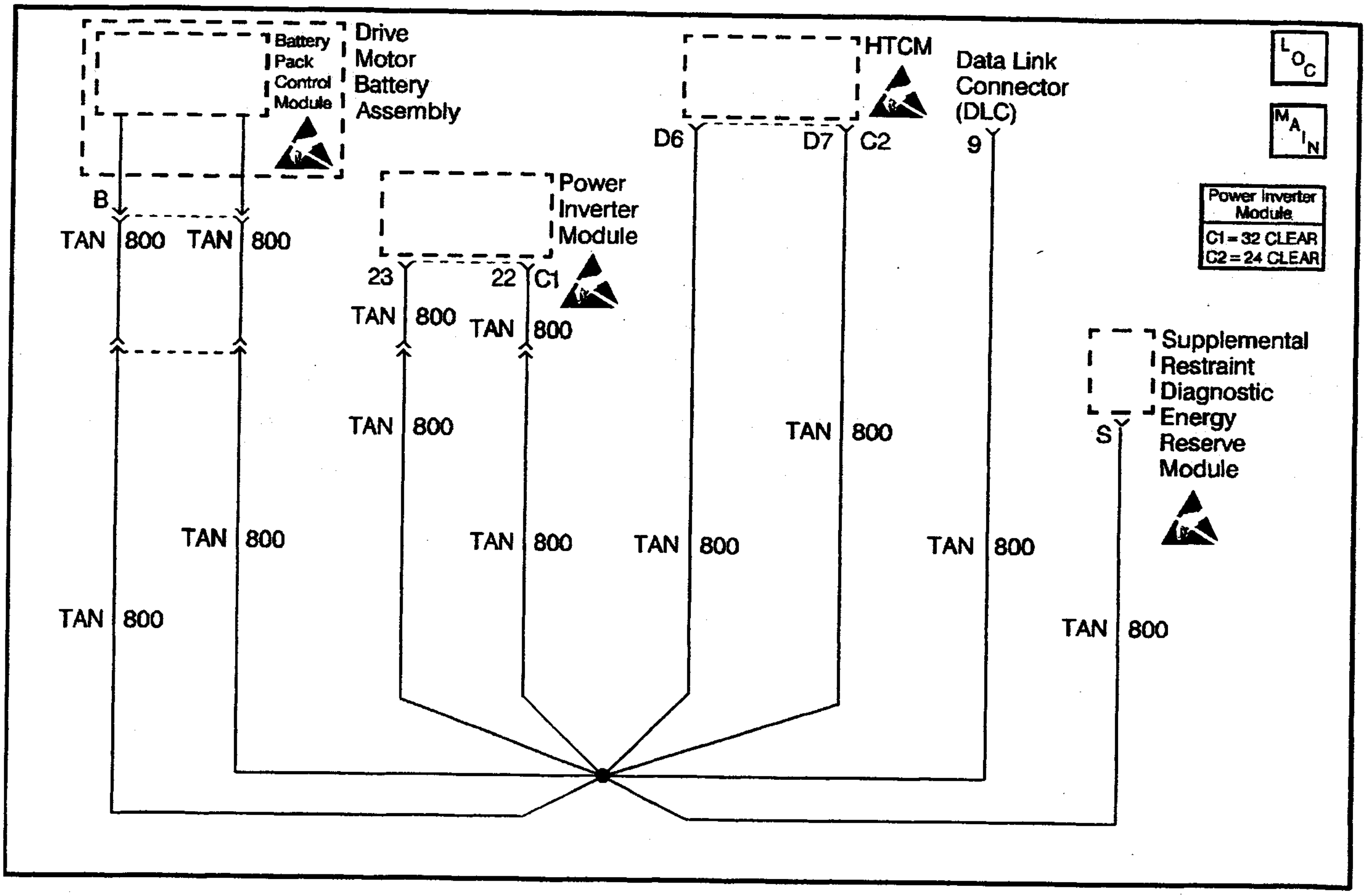
Check for the following conditions:

- Using the special function feature of the scan tool, command the Indicator Lamp ON.

No BATT LIFE Indicator Lamp

Step	Action	Value(s)	Yes	No
1	Were you sent here from the On-Board Diagnostic (OBD) System Check?	—	Refer to section 8C1	Go to *OBD System Check*

No Serial Data



Battery Pack Control Module
Drive Motor Battery Assembly
B
TAN 800 TAN 800
Power Inverter Module
23
22 C1
HTCM
D6
D7 C2
Data Link Connector (DLC)
9
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Supplemental Restraint Diagnostic Energy Reserve Module
S
TAN 800

264084

Circuit Description

UART is an interfacing device that allows the on board computers to send and receive serial data. Serial data refers to information which is transferred in a linear fashion - over a single line, one bit at a time. The UART system uses a redundant wire system to ensure communications even if one line has an open. There should always be a steady SERVICE SOON lamp for 3 to 5 seconds when the ignition is ON during a bulb check. Battery voltage is supplied to the lamp through the instrument cluster. The Drive Motor Control Module turns the lamp on by applying a ground to the control circuit during a bulb check or when a DTC sets and the DTC meets the requirements for illuminating the lamp. The SERVICE NOW and BATT LIFE lamps are illuminated by the Instrument Panel Cluster which is a Class 2 controlled device.

Diagnostic Aids

Check for the following conditions:

- A grounded serial data line will pull the entire circuit low and not allow any communication.
- The UART system uses a redundant wire system to ensure communications even if one line has an open. If only one control module will not talk on the serial data line check the control module.

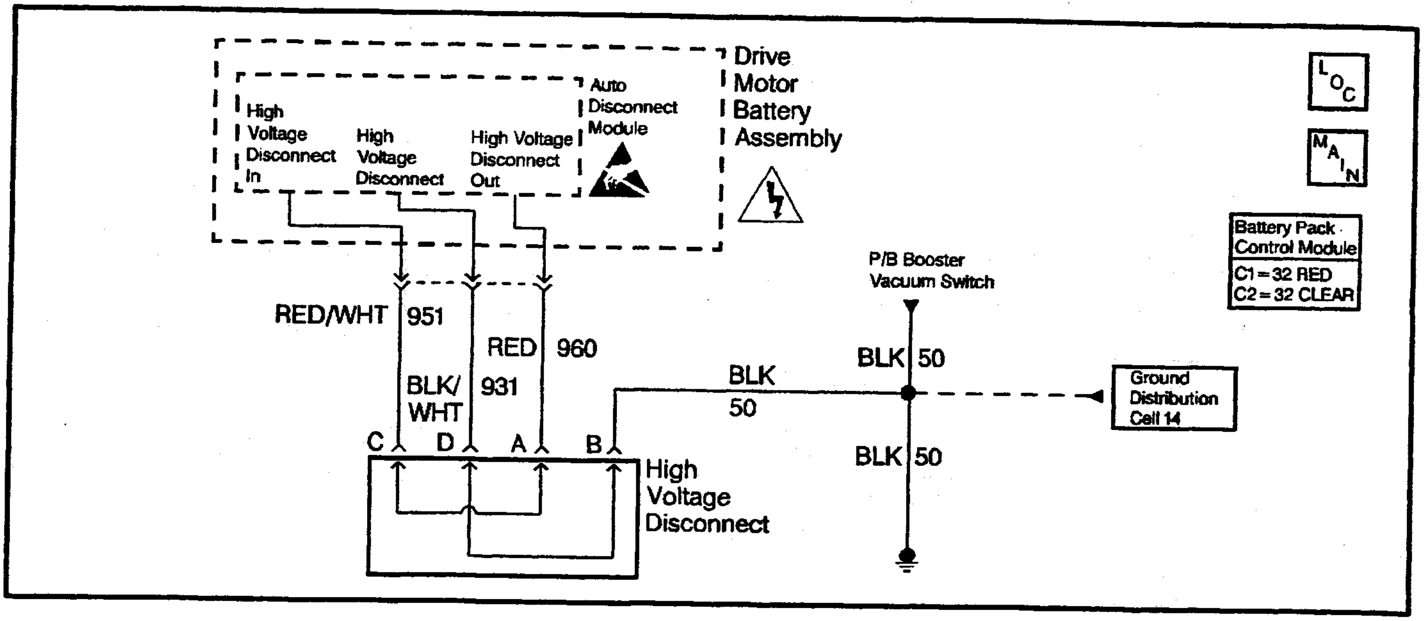
Test Description

2. This step checks for communications with all controllers.
6. This step checks for a problem on the serial data circuit.

No serial Data

Step	Action	Value(s)	Yes	No
1	Were you sent here from the On-Board Diagnostic (OBD) System Check?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool attempt to access serial data from the Drive Motor Control Module, Battery Pack Control Module, and HTCM. Is any serial data present?	—	Go to Step 3	Go to Step 6
3	Can the scan tool communicate with the Battery Pack Control Module?	—	Go to Step 4	Go to Step 7
4	Can the scan tool communicate with the Drive Motor Control Module?	—	Go to Step 5	Go to Step 8
5	Can the scan tool communicate with the HTCM?	—	System OK	Go to Step 9
6	1. Turn OFF the ignition switch. 2. Check for an open in the serial data circuit. 3. Check for a short to ground in the serial data circuit. 4. Check for a short to voltage in the serial data circuit. Is the action complete?	—	Go to Step 10	—
7	Check for an open or poor connection between the Battery Pack Control Module and the splice. Was a problem found?	—	Go to Step 10	Go to Step 11
8	Check for an open or poor connection between the Power Inverter Module and the splice. Was a problem found?	—	Go to Step 10	Go to Step 12
9	Check for an open or poor connection between the HTCM and the splice. Was a problem found?	—	Go to Step 10	Go to Step 13
10	Repair the wiring harness as required. Refer to *Wiring Repairs* in *Wiring Systems.* Is the repair complete?	—	Go to *OBD System Check*	—
11	Replace the Battery Pack Control Module. Refer To *Battery Pack Service Manual.* Is the repair complete?	—	Go to *OBD System Check*	—
12	Replace the Drive Motor Control Module. Refer To *Power Inverter Module Assembly Removal and Installation.* Is the repair complete?	—	Go to *OBD System Check*	—
13	Replace the HTCM. Refer To *HTCM Removal and Installation.* Is the repair complete?	—	Go to *OBD System Check*	—

High Voltage Disable Procedure


Drive Motor Battery Assembly
Auto Disconnect Module
High Voltage Disconnect In
High Voltage Disconnect
High Voltage Disconnect Out
RED/WHT 951
BLK/WHT 931
RED 960
BLK 50
C
D
A
B
High Voltage Disconnect
P/B Booster Vacuum Switch
BLK 50
BLK 50
Ground Distribution Cell 14
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR

264072

Circuit Description

The high voltage disconnect connector is the end of a four wire extension from the automatic disconnect. By removing the connector the ground path to the high voltage relays are removed. At the same time a internal battery pack ground unbalance is created that requires the automatic disconnect to command the high voltage open. The high voltage disconnect connector should be locked in the glove-box or other secure area during vehicle service.

Diagnostic Aids

Check for the following conditions:

- An audible click should be heard when the high voltage disconnect connector is removed. This click indicates the automatic disconnect high voltage relays have opened.
- If the High Voltage Disconnect is removed with the key ON Battery Pack Control Module DTC 278 and Drive Motor Control Module DTC 070 will be set. After removing the High Voltage Disconnect, Connect a scan tool to the data link connector (DCL) and view the Diagnostic Trouble Codes. Battery Pack Control Module DTC 278 and Drive Motor Control Module DTC 070 should be present, which indicates the Battery Pack Control Module and Auto Disconnect recognized a high voltage disconnect.
- Using a scan tool, the voltage on the Power Inverter Module High Voltage buss can be read through the Drive Motor Control Module data list.

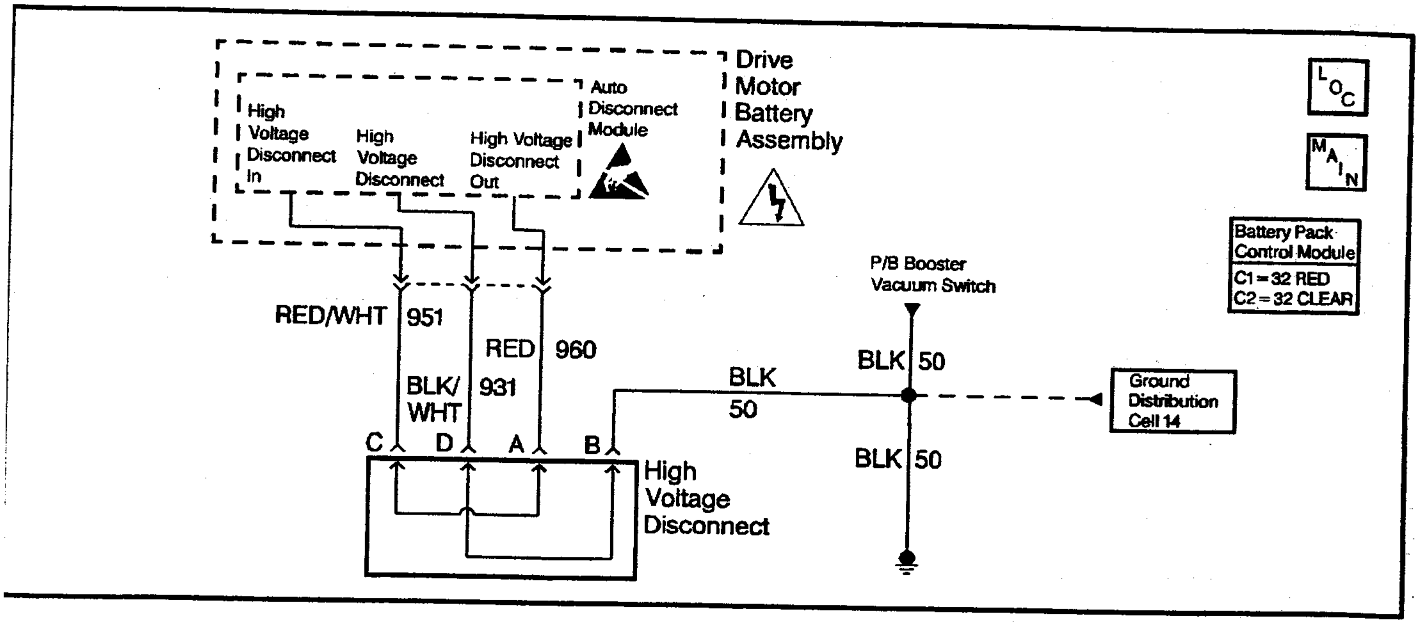
Test Description

1. Checks for other related Diagnostic Trouble Codes.
3. This is the initial step in containing high voltage inside the battery pack.
4. Checks for remaining high voltage through the use of the power steering pump.
5. This is the physical check of the battery connector to assure no high voltage is present.
6. This step checks if the high voltage can be depleted by the power steering pump or if the battery pack high voltage has not been disabled.

High Voltage Disable Procedure

Step	Action	Value(s)	Yes	No
1	**Important:** The OBD System Check must be performed prior to performing the High Voltage Disable Procedure. Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Was a Drive Motor Control Module DTC 105 set?	—	Go to DTC 105 first	Go to Step 3
3	***Notice:*** During charging, do not remove the high voltage service disconnect. Vehicle damage will result. ***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled.*** With the key OFF and the charger disconnected remove the manual high voltage service disconnect. Is the action complete?	—	Go to Step 4	—
4	Turn the key ON and check if the power steering pump runs after the specified time. ***Notice:*** The power steering pump requires 20 seconds to initialize after key up. Did the power steering pump run after the specified time?	20 seconds	Go to Step 6	Go to Step 5
5	***Caution: Always treat high voltage cables and connectors as if voltage is present.*** 1. Remove the battery pack high voltage cannon connector from the back of the Inverter Module. 2. Using a DMM probe the two large terminals on the battery pack cable cannon connector. Is the voltage less than the specified value?	5 Volts	Go to Step 9	Go to Step 7
6	Did the power steering pump run longer then the specified value?	1 minute	Go to Step 7	Go to Step 8
7	***Caution: The Battery pack high voltage system did not power down. The high voltage system still contains high voltage.*** Internal Battery Pack service is required. Refer to the *Battery Pack Service Manual.*	—	—	—
8	Replace the Power Inverter Module. Refer to *Power Inverter Module Assembly Removal and Installation.* ***Notice:*** If the control module is faulty, the new control module must be programmed. Refer to *control module programming procedures.* Is the action complete?	—	Go to Step 9	—
9	Proceed with vehicle service.	—	—	—

High Voltage Enable Procedure


Drive Motor Battery Assembly
Auto Disconnect Module
High Voltage Disconnect In
High Voltage Disconnect
High Voltage Disconnect Out
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
P/B Booster Vacuum Switch
RED/WHT 951
RED 960
BLK/WHT 931
BLK 50
BLK 50
BLK 50
Ground Distribution Cell 14
C D A B
High Voltage Disconnect

264072

Circuit Description

The high voltage disconnect connector is the end of a four wire extension from the automatic disconnect. By removing the connector the ground path to the high voltage relays are removed. At the same time a internal battery pack ground imbalance is created that requires the automatic disconnect to command the high voltage open. The high voltage disconnect connector should be locked in the glove box or other secure area during vehicle service.

Test Description

1. Checks for other related Diagnostic Trouble Codes.
2. Checks that the high voltage wiring is connected.
3. Supplies the ground paths back to the automatic disconnect and the high voltage relays

High Voltage Enable Procedure

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Ensure that all wiring with orange conduit is connected to proper components. Is the action complete?	—	Go to Step 3	—
3	***Notice:*** Do not enable the high voltage system with the charger connected to the charge receptacle. Vehicle damage will result. With the key OFF and the charger disconnected replace the manual high voltage service disconnect. Is the action complete?	—	Go to Step 4	—
4	Turn the key ON and check each control module for DTC(s). Were any DTC(s) present?	—	Go to other DTC(s)	System OK

Drive Motor Control Module Diagnostic Trouble Codes

DTC	Description	MIL Illuminated
001	Power Inverter Module Temperature Sensor Circuit Low	SERVICE SOON
002	Power Inverter Module Temperature Sensor Circuit High	SERVICE SOON
003	Drive Motor Winding Temperature Sensor Circuit Low	SERVICE SOON
004	Drive Motor Winding Temperature Sensor High	SERVICE SOON
005	Battery Pack Circuit Low Voltage	SERVICE NOW
006	Battery Pack Circuit High Voltage	SERVICE NOW
007	Drive Motor Speed Sensor Circuit High	SERVICE NOW
008	Drive Motor Speed Sensor Performance	SERVICE SOON
009	Drive Motor Speed Sensor Circuit Low	SERVICE NOW
014	Accelerator Pedal Position Sensor 1 Circuit Low	SERVICE SOON, SERVICE NOW
015	Accelerator Pedal Position Sensor 1 Circuit High	SERVICE SOON, SERVICE NOW
016	Accelerator Pedal Position Sensor 1 Circuit Performance	SERVICE SOON, SERVICE NOW
017	Accelerator Pedal Position Sensor 2 Circuit Low	SERVICE SOON, SERVICE NOW
018	Accelerator Pedal Position Sensor 2 Circuit High	SERVICE SOON, SERVICE NOW
019	Accelerator Pedal Position Sensor 2 Circuit Performance	SERVICE SOON, SERVICE NOW
020	Accelerator Pedal Position Sensor 3 Circuit Low	SERVICE SOON, SERVICE NOW
021	Accelerator Pedal Position Sensor 3 Circuit High	SERVICE SOON, SERVICE NOW
022	Accelerator Pedal Position Sensor 3 Circuit Performance	SERVICE SOON, SERVICE NOW
023	Accelerator Pedal Position Sensor Circuits 1 and 2	SERVICE SOON, SERVICE NOW
024	Accelerator Pedal Position Sensor Circuits 1 and 3	SERVICE SOON, SERVICE NOW
025	Accelerator Pedal Position Sensor Circuits 2 and 3	SERVICE SOON, SERVICE NOW
026	Loss of Communications With Battery Pack Control Module	SERVICE SOON
029	Loss of Communications With HTCM	SERVICE SOON
030	Drive Motor Control Module Circuit	SERVICE SOON
031	Drive Motor Control Module Circuit	SERVICE SOON
034	Power Inverter Module Temperature Sensor Circuit Out Of Range	TEMP
036	Performance Limited	TEMP
037	Drive Motor Winding Temperature Sensor Out of Range	TEMP
043	Power Inverter Module Speed and Direction Sensor Circuit	SERVICE NOW
044	Power Inverter Module Bias Control System	SERVICE NOW
045	Power Inverter Module Bias Control Voltage Low	SERVICE NOW
048	Drive Motor Control Module Circuit	SERVICE SOON (flash)
049	Drive Motor Control Module Circuit	SERVICE SOON (flash)
050	Drive Motor Control Module Circuit	SERVICE SOON (flash)
053	Battery Pack Reduced Performance	SERVICE SOON
059	Drive Motor Control Module Keep Alive Memory Circuit Low Voltage	SERVICE NOW

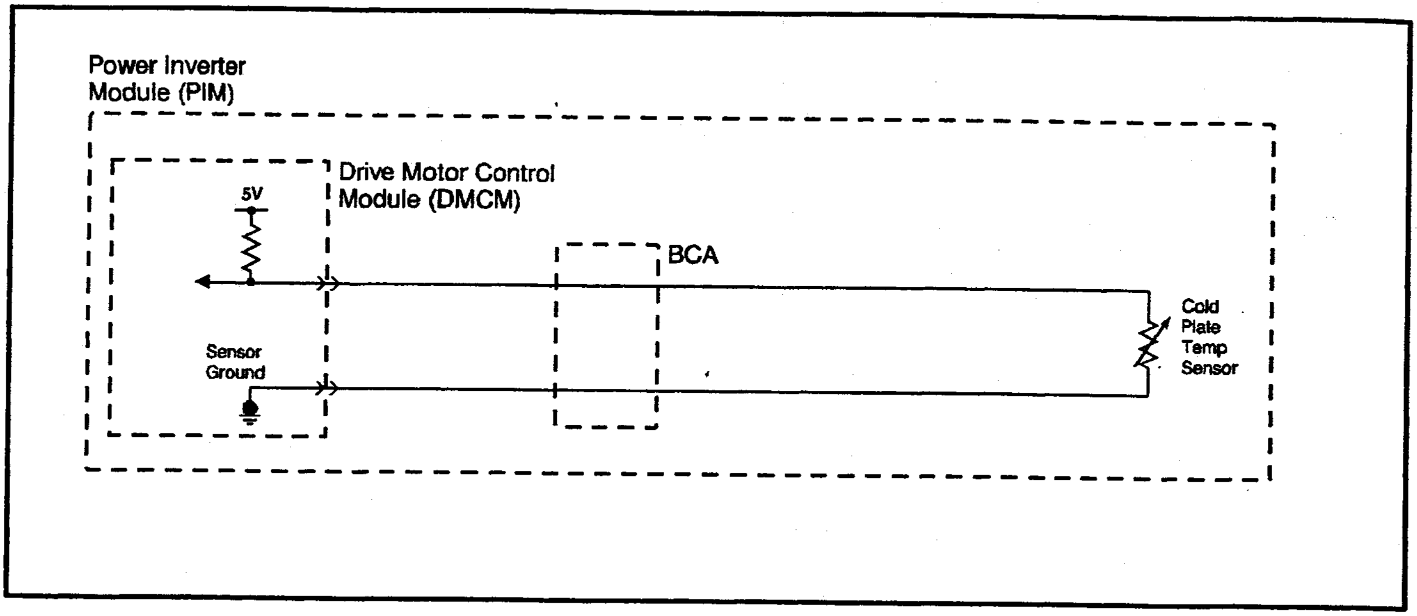
Drive Motor Control Module Diagnostic Trouble Codes (continued)

DTC	Description	MIL Illuminated
060	Drive Motor Control Module Keep Alive Memory Circuit High Voltage	SERVICE NOW
061	Transmission Range Indicator Circuit	—
062	Cruise Set Circuit	—
063	Cruise Resume Circuit	—
065	Cruise Set Circuit High at Power-up	—
067	Cruise Resume Circuit High at Power-up	—
069	Power Inverter Module Phase Current Circuit High at Power-up	SERVICE NOW
070	High Voltage Interlock Circuit	WAIT
071	Battery Pack Power-up Check Voltage Low	SERVICE NOW
072	Battery Pack Power-up Check Voltage High	SERVICE NOW
073	Power Inverter Module Bias Control Enable Power-up Check	SERVICE SOON
074	Drive Motor Speed Variation	SERVICE NOW
075	Drive Motor Control Module Reset Occurred	SERVICE SOON (flash)
076	Power Inverter Module Speed and Direction Sensor Circuit	SERVICE NOW
079	Drive Motor Change of Direction	SERVICE NOW
080	Drive Motor Zero Speed	SERVICE NOW
081	Power Inverter Module Phase 1 Current Out of Range	SERVICE NOW
082	Power Inverter Module Phase 2 Current Out of Range	SERVICE NOW
083	Power Inverter Module Phase 3 Current Out of Range	SERVICE NOW
084	Power Inverter Module Phase Voltage High	SERVICE NOW
085	Power Inverter Module Phase Voltage Low	SERVICE NOW
087	Power Inverter Module Bias Control System	—
088	Power Inverter Module Bias Control Current Command	—
089	Forward Control Circuit Failed Power-up	SERVICE NOW
090	Reverse Control Circuit Failed Power-up	SERVICE NOW
095	Brake Switch Circuit Low	SERVICE SOON
096	Brake Switch Circuit High	SERVICE SOON
097	Charge Paddle Present Correlation	SERVICE SOON
098	APP 5 Volt Reference 2 Low	SERVICE SOON
099	APP 5 Volt Reference 2 High	SERVICE SOON
100	APP 5 Volt Reference 3 Low	SERVICE SOON
101	APP 5 Volt Reference 3 High	SERVICE SOON
102	Reduced Performance State of Charge Low	—
104	Aux. Battery Charge Low Voltage	SERVICE NOW

Drive Motor Control Module Diagnostic Trouble Codes (continued)

DTC	Description	MIL Illuminated
105	High Voltage Discharge Circuit Voltage High	SERVICE SOON
111	Power Inverter Module Bias Control Phase Voltage Out of Range	SERVICE NOW
112	Output Control 1 Performance	SERVICE SOON
115	Power Inverter Module Bias Control Phase Current Circuit High During Coast	SERVICE SOON
116	Power Inverter Module Bias Control Phase Current Circuit High During Accel	SERVICE NOW
117	Power Inverter Module Bias Control Phase Current Command Low	SERVICE NOW
118	Power Inverter Module Bias Control Phase Current Circuit Low During Coast	SERVICE SOON
119	Power Inverter Module Bias Control Phase Current Circuit Low During Accel	SERVICE SOON

DTC 001 Power Inverter Module Temperature Sensor Circuit Low


Power Inverter Module (PIM)
Drive Motor Control Module (DMCM)
5V
BCA
Sensor Ground
Cold Plate Temp Sensor
177155

Circuit Description

The Power Inverter Module Temperature Sensor is a thermistor which senses the inverter cold-plate temperature. The Drive Motor Control Module applies a 5 Volt reference to the thermistor and monitors the voltage on the return line. This voltage is converted to a temperature value by the Drive Motor Control Module. The temperature sensor is internal to the Power Inverter Module and is not serviceable. The HTCM uses this temperature value to determine the need for Power Inverter Module cooling.

Conditions for Setting the DTC

- Key ON.
- Temperature sensor voltage is less than 0.02 volts for ten (10) seconds.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE SOON light.
- A default temperature value of -40°C (-40°F) will be used for internal processing (this will be displayed on the scan tool).
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- The Drive Motor Control Module will turn the SERVICE SOON light OFF 10 seconds after the diagnostic has been run and the fault condition is no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- A default temperature value of -40°C (-40°F) will be displayed on the scan tool.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

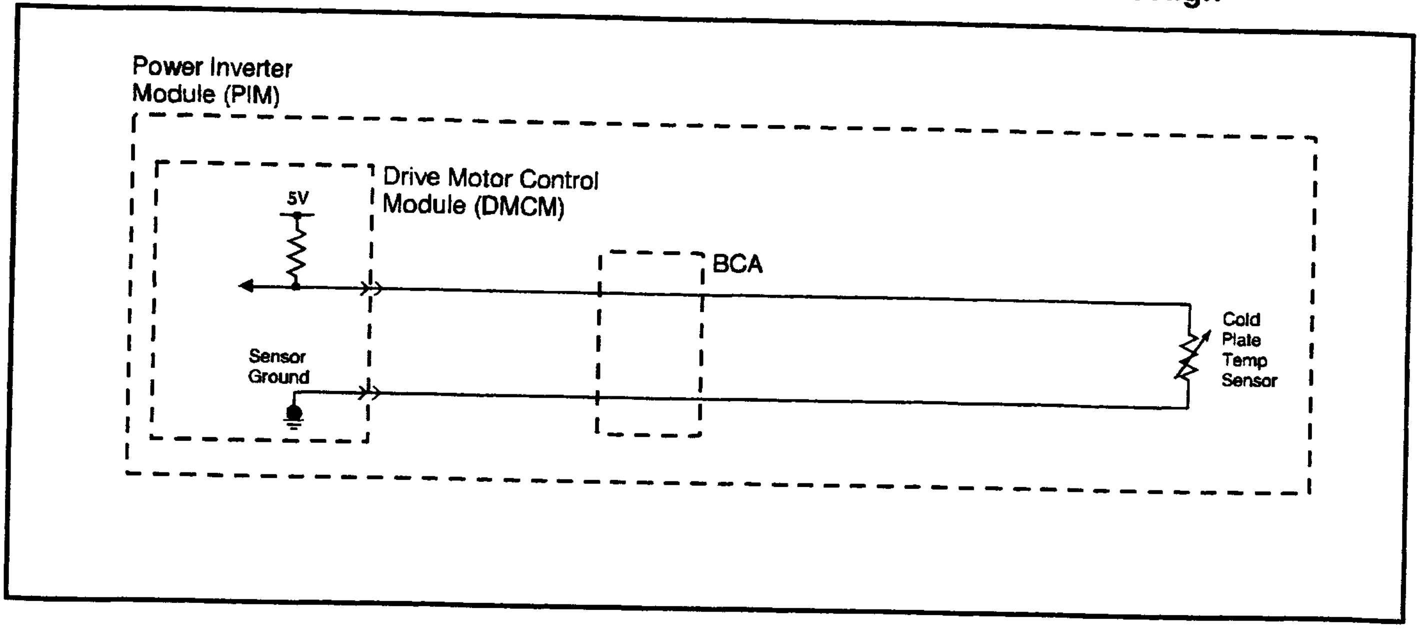
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This determines if the DTC is the result of a hard failure or an intermittent condition.

DTC 001 Power Inverter Module Temperature Sensor Circuit Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is DTC 001 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Replace the Power Inverter Module. Refer to *Power Inverter Module Assembly Removal and Installation.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 002 Power Inverter Module Temperature Sensor Circuit High


Power Inverter Module (PIM)
Drive Motor Control Module (DMCM)
5V
Sensor Ground
BCA
Cold Plate Temp Sensor
177155

Circuit Description

The Power Inverter Module Temperature Sensor is a thermistor which senses the inverter cold-plate temperature. The Drive Motor Control Module applies a 5 Volt reference to the thermistor and monitors the voltage on the return line. This voltage is converted to a temperature value by the Drive Motor Control Module. The temperature sensor is internal to the Power Inverter Module and is not serviceable. The HTCM uses this temperature value for Power Inverter Module cooling.

Conditions for Setting the DTC

- Temperature sensor voltage is greater than 4.7 volts for ten (10) seconds.

Action Taken When the DTC Sets

- The Drive Motor Control Module will illuminate the SERVICE SOON light.
- A default temperature value of -40°C (-40°F) will be used for internal processing (this will be displayed on the scan tool).
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- The Drive Motor Control Module will turn the SERVICE SOON light OFF 10 seconds after the diagnostic has been run and the fault condition is no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- A default temperature value of -40°C (-40°F) will be displayed on the scan tool.
- The HTCM uses this temperature value for Power Inverter Module cooling
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

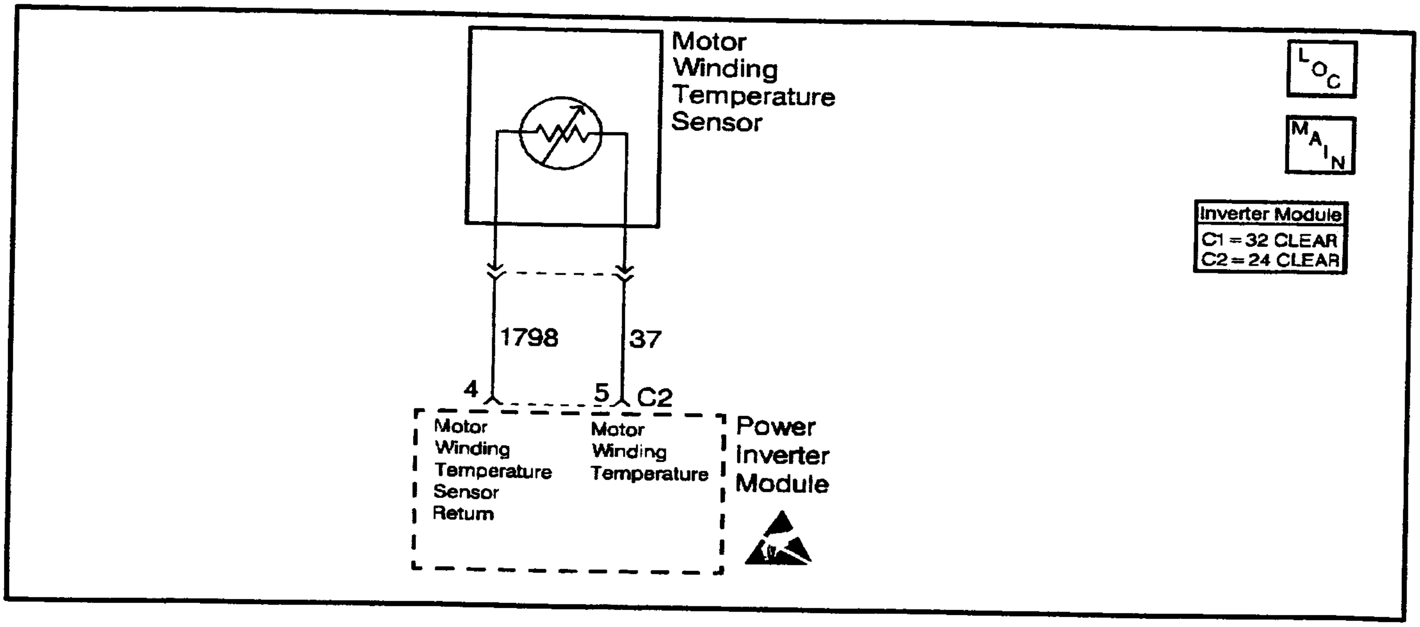
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This determines if DTC 002 is the result of a hard failure or an intermittent condition.

DTC 002 Power Inverter Module Temperature Sensor Circuit High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is DTC 002 current?		Go to Step 3	Go to Diagnostic Aids
3	Replace the Power Inverter Module. Refer to *Power Inverter Module Assembly Removal and Installation.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 003 Drive Motor Winding Temperature Sensor Circuit Low


Motor Winding Temperature Sensor
LOC
MAIN
Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
1798
37
4
5
C2
Motor Winding Temperature Sensor Return
Motor Winding Temperature
Power Inverter Module

108060

Circuit Description

The Drive Motor Winding Temperature Sensor is a thermistor which senses the motor winding temperature. The Drive Motor Control Module applies a 5 volt reference to the thermistor and monitors the voltage on the return line. This voltage is converted to a temperature value by the Drive Motor Control Module. The drive motor winding temperature sensor is located within the windings of the motor and is not serviceable.

Conditions for Setting the DTC

- The temperature sensor voltage is less than 0.02 volts for ten (10) seconds.

Action Taken When the DTC Sets

- The Drive Motor Control Module will illuminate the SERVICE SOON light.
- The DTC will be stored in failure records buffer.
- A default temperature value of 30°C (86°F) will be used for internal processing (this will be displayed on the scan tool).

Conditions for Clearing the DTC

- The Drive Motor Control Module will turn the SERVICE SOON light OFF 10 seconds after the diagnostic has been run and the fault condition is no longer present.
- The DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- A default temperature value of 30°C (86°F) will be displayed on the scan tool.
- Inspect the wiring harness to the Drive Motor Temperature Sensor for an intermittent short to ground.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.
- Use the Table below to check for a skewed sensor.

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	314K
-30	-22	168K
-20	-4	936K
0	32	320K
10	50	197K
20	68	197K
30	86	80K
40	104	54K
50	122	36K
60	140	25K
70	158	18K
80	176	12.7K
90	194	9284
100	212	6861
110	230	5143
120	248	3907
130	266	3004
140	284	2337
150	302	1837
160	320	1456
170	338	1166
180	356	943
190	374	769
200	392	633

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

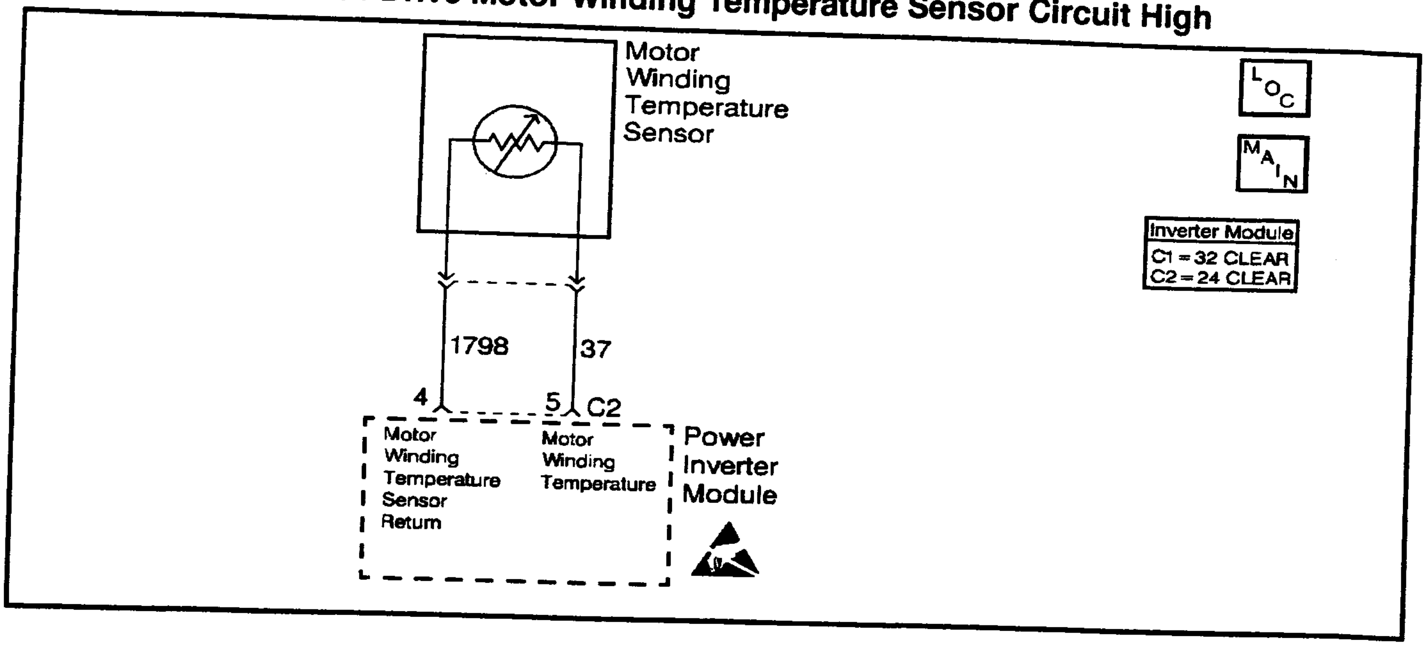
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This determines if DTC 003 is the result of a hard failure or an intermittent condition.
3. Removes the resistor from the circuit and forces the control module to read default value.

DTC 003 Drive Motor Winding Temperature Sensor Circuit Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is DTC 003 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Does the scan tool display Drive Motor temperature at the specified value?	30°C (86°F)	Go to Step 4	Go to Step 7
4	Check the connections at the drive motor temperature sensor harness for loose or damaged terminals. Was a problem found ?	—	Go to Step 8	Go to Step 5
5	Using a DMM measure the resistance between terminals A and B of the drive motor winding temperature sensor. Is the resistance less than the specified value?	1,600 ohms	Go to Step 9	Go to Step 6
6	Check for short to ground, or poor connections between the Power Inverter Module 24-way harness connector and the drive motor winding temperature sensor harness connector. Was a problem found?	—	Go to Step 8	Go to Step 7
7	Replace the Power Inverter Module. Refer to Power Inverter Module Assembly Removal and Installation. Is the repair complete?	—	Go to Step 10	—
8	Repair the short to ground, or poor connections between Power Inverter Module 24-way harness connector and the drive motor winding temperature sensor harness connector in harness terminal connections. Is the repair complete?	—	Go to Step 10	—
9	Replace the drive motor assembly. Is the repair complete?	—	Go to Step 10	—
10	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 004 Drive Motor Winding Temperature Sensor Circuit High



108060

Circuit Description

The Drive Motor Winding Temperature Sensor is a thermistor which senses the motor winding temperature. The Drive Motor Control Module applies a 5 volt reference to the thermistor and monitors the voltage on the return line. This voltage is converted to a temperature value by the Drive Motor Control Module. The motor winding temperature sensor is located within the windings of the motor and is not serviceable.

Conditions for Setting the DTC

- Temperature sensor voltage is greater than 4.98 volts for ten (10) seconds.

Action Taken When the DTC Sets

- The Drive Motor Control Module will illuminate the SERVICE SOON light.
- The DTC will be stored in failure records buffer.
- A default temperature value of 30°C (86°F) will be used for internal processing (this will be displayed on the scan tool).

Conditions for Clearing the DTC

- The Drive Motor Control Module will turn the SERVICE SOON light OFF 10 seconds after the diagnostic has been run and the fault condition is no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- A default temperature value of 30°C (86°F) will be displayed on the scan tool.
- Inspect harness connectors for backed out terminals, improper mating, broken locks, improperly formed or damaged terminals, and poor terminal to wire connection.
- Inspect the wiring harness to the Drive Motor Temperature Sensor for an intermittent short circuit.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.
- Use the Table below to check for a skewed sensor.

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	314K
-30	-22	168K
-20	-4	936K
0	32	320K
10	50	197K
20	68	197K
30	86	80K
40	104	54K
50	122	36K
60	140	25K
70	158	18K
80	176	12.7K
90	194	9284
100	212	6861
110	230	5143
120	248	3907
130	266	3004
140	284	2337
150	302	1837
160	320	1456
170	338	1166
180	356	943
190	374	769
200	392	633

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This determines if DTC 004 is the result of a hard failure or an intermittent condition.
3. Creates an infinite resistance on the circuit and forces the control module to read default value.

DTC 004 Drive Motor Temperature Sensor Circuit High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is DTC 004 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Does the scan tool display Drive Motor temperature at the specified value?	30°C (86°F)	Go to Step 4	Go to Step 7
4	Check the connections at the drive motor temperature sensor harness for loose or damaged terminals. Was a problem found ?	—	Go to Step 8	Go to Step 5
5	Using a DMM measure the resistance between terminals A and B of the drive motor winding temperature sensor. Is the resistance greater the specified value?	1,000,000 ohms	Go to Step 9	Go to Step 6
6	Check for open, or poor connections between the Power Inverter Module 24-way harness connector and the drive motor winding temperature sensor harness connector. Was a problem found?	—	Go to Step 8	Go to Step 7
7	Replace the Power Inverter Module. Refer to Power Inverter Module Assembly Removal and Installation. Is the repair complete?	—	Go to Step 10	—
8	Repair the open, or poor connections between Power Inverter Module 24-way harness connector and the drive motor winding temperature sensor harness connector in harness terminal connections. Is the repair complete?	—	Go to Step 10	—
9	Replace the drive motor assembly. Is the repair complete?	—	Go to Step 10	—
10	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 005 Battery Pack Circuit Low Voltage

Circuit Description

The Drive Motor Control Module monitors the battery pack voltage continuously during operation. The Bias Control Assembly supplies an isolated, scaled (1 volt = 100 volts) battery voltage signal to the Drive Motor Control Module. The Bias Control Assembly board is located inside the Power Inverter Module and is not serviceable.

Conditions for Setting the DTC

- Automatic disconnect is closed.
- No critical BCA faults are present.
- Drive Motor Control Module sees battery pack voltage less then 180 volts for any length of time.

Action Taken When the DTC Sets

- The Drive Motor Control Module will request the Battery Pack Control Module to illuminate the SERVICE NOW light.
- The DTC will be stored in failure records buffer.
- Propulsion is disabled.
- Drive Motor Control Module will display 225 volts as a default value on the scan tool.

Conditions for Clearing the DTC

- The ignition must be cycled once after the fault condition is no longer present. The DTC is latched for one ignition cycle.
- DTC can be cleared by using the scan tool Clear Info function .

Diagnostic Aids

Check for the following conditions:

- Check for Battery Pack Control Module codes first.
- If history data shows DTC set during WOT with low SOC battery pack voltage may have been temporarily low enough to set DTC 005.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the battery pack has a fault this DTC may be set in conjunction.
3. This check determines if the fault is present.
5. J 42493 is used to determine which control module is displaying the correct battery pack voltage value.
8. Checks for the RUN 2 voltage signal to the Power Inverter Module.

DTC 005 Battery Pack Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any Battery Pack Control Module DTCs present?	—	Refer To other DTCs	Go to Step 3
3	Is Drive Motor Control Module DTC 005 current?	—	Go to Step 4	Go to Diagnostic Aids
4	Is Drive Motor Control Module DTC 045 also set?	—	Go to Step 8	Go to Step 5
5	Using a scan tool view the Battery Pack Control Module battery pack voltage. Is the Battery Pack Control Module battery pack voltage greater than the specified value?	190 Volts	Go to Step 6	Go to Step 7

DTC 005 Battery Pack Circuit Low Voltage (continued)

Step	Action	Value(s)	Yes	No
6	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled.*** 1. Disable high voltage. Refer To High Voltage Disable Procedure. 2. Disconnect the battery pack high voltage canon connector at the Power Inverter Module. 3. Install the high voltage jumper harness J 42493 4. Re-enable high voltage by reconnecting the high voltage service disconnect. 5. With vehicle ignition switch in the RUN position read the voltage on the jumper harness J 42493 Does the jumper harness J 42493 voltage match Battery Pack Control Module voltage within the specified range?	± 10 Volts	Go to Step 10	Go to Step 11
7	Charge battery pack to completion. Is the action complete?	—	Go to Step 12	—
8	1. Turn the ignition to OFF. 2. Disconnect the Power Inverter Module 32 way connector. 3. Connect a DMM set to DC volts at the RUN 2 circuit on the Power Inverter Module 32 way connector. 4. Turn the ignition ON and check the voltage on the RUN 2 circuit. Is the voltage above the specified value?	12 volts	Go to Step 10	Go to Step 9
9	Repair the open in the RUN 2 voltage circuit to the Power Inverter Module 32 way connector. Is the repair complete?	—	Go to Step 12	—
10	Replace the Power Inverter Module. Refer to Power Inverter Module Assembly Removal and Installation. Is the repair complete?	—	Go to Step 12	—
11	Battery pack service is required. Refer To *Battery Pack Service Manual.* Is the repair complete?	—	Go to Step 12	—
12	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 006 Battery Pack Circuit High Voltage

Circuit Description

The Drive Motor Control Module monitors the battery pack voltage continuously during operation. The Bias Control Assembly supplies an isolated, scaled (1 volt = 100 volts) battery voltage signal to the Drive Motor Control Module. The Bias Control Assembly board is located inside the Power Inverter Module and is not serviceable.

Conditions for Setting the DTC

- Automatic disconnect is closed.
- No critical BCA faults are present.
- Drive Motor Control Module sees battery pack voltage greater than 440 volts for any length of time.

Action Taken When the DTC Sets

- The Drive Motor Control Module will illuminate the SERVICE NOW light.
- DTC will be stored in failure records buffer.
- propulsion disabled.
- Drive Motor Control Module will display 225 volts as a default value on the scan tool.

Conditions for Clearing the DTC

- The ignition must be cycled once after the fault condition is no longer present. The DTC is latched for one ignition cycle.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Look for Battery Pack Control Module DTC 222 and refer to related chart.
- In the event that the fault can not be duplicated in the service bay, it is possible that the customers charger could be at fault. It may be necessary to have the customers charger checked and repaired.
- View malfunction history, if DTC set during regeneration the fault is most likely in the Power Inverter Module. Duplicate driving conditions to verify.
- If Drive Motor Control Module DTC 072 is also set continue with DTC 006 diagnostic chart then proceed to the OBD System Check.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

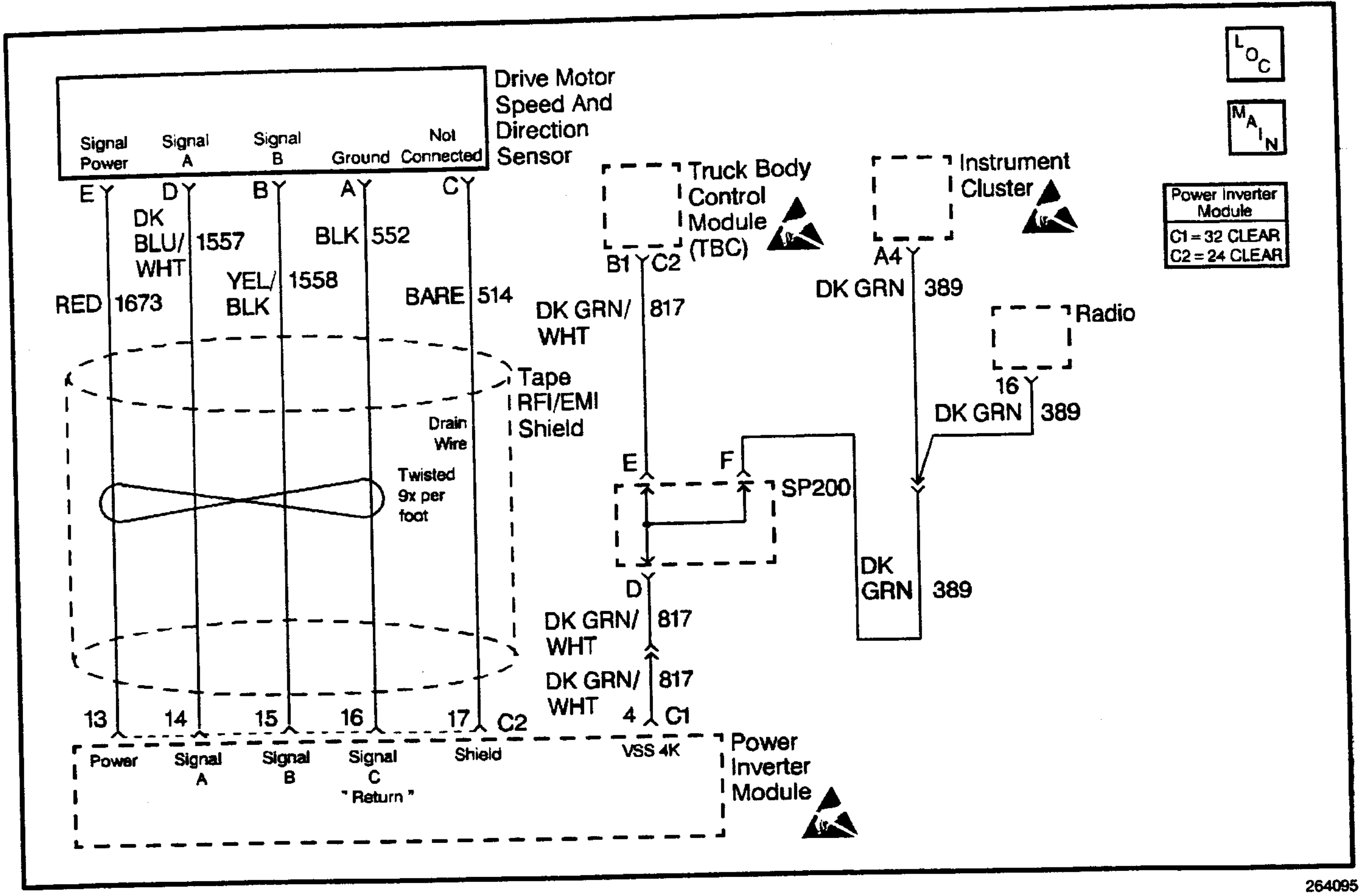
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Battery Pack Control Module DTCs will lead to battery pack diagnosis.
3. Checks that each control module reads the same voltage value.

DTC 006 Battery Pack Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any Battery Pack Control Module DTCs present other than DTC 072?	—	Go to Battery Pack Control Module DTC(s)	Go to Step 3
3	1. Turn the ignition OFF. 2. Turn the ignition ON. 3. Clear DTC from Drive Motor Control Module. 4. charge the vehicle to completion. Did DTC 006 reset with no other Battery Pack Control Module DTC(s)?	—	Go to Step 4	Go to Diagnostic Aids
4	Replace the Power Inverter Module. Refer to Power Inverter Module Assembly Removal and Installation. Is the repair complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 007 Drive Motor Speed and Direction Sensor Circuit High


LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Drive Motor Speed And Direction Sensor
Signal Power
Signal A
Signal B
Ground
Not Connected
E
D
B
A
C
DK BLU/ WHT
1557
BLK
552
RED
1673
YEL/ BLK
1558
BARE
514
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
Truck Body Control Module (TBC)
B1
C2
DK GRN/ WHT
817
Instrument Cluster
A4
DK GRN
389
Radio
16
DK GRN
389
E
F
SP200
D
DK GRN/ WHT
817
DK GRN
389
DK GRN/ WHT
817
4
C1
13
14
15
16
17
C2
Power
Signal A
Signal B
Signal C "Return"
Shield
VSS 4K
Power Inverter Module

264095

Circuit Description

The Drive Motor Control Module monitors the Drive Motor Speed and Direction Sensor signal for several different functions including vehicle speed, torque control, and cruise control. The Bias Control Assembly generates a signal which has 1 pulse for each pulse of the dual square wave signal sent by the Drive Motor Speed and Direction Sensor. The Drive Motor Speed and Direction Sensor is located in the left hand side of the drive motor.

Conditions for Setting the DTC

- The automatic disconnect is closed.
- The Drive Motor Control Module receives a pulse rate greater than 8533 Hz on the Drive Motor Speed and Direction Sensor input. This corresponds to a shaft speed of 16000 RPM or a vehicle speed of 100 MPH.

Action Taken When the DTC Sets

- The Drive Motor Control Module will illuminate the SERVICE NOW light.
- DTC will be stored in failure records buffer.
- propulsion is disabled.
- Cruise is disabled.
- Drive Motor Speed and Direction value defaults to 16000 RPM.

Conditions for Clearing the DTC

- The SERVICE NOW light will be turned OFF after 10 seconds of a no fault condition.
- Propulsion will remain disabled until the next ignition cycle.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- This DTC may set if the vehicle speed exceeds calibrated values such as going down a hill.
- Check 12 volt speed/direction sensor supply voltage.
- Review Drive Motor Control Module DTC(s) 079 and 080.
- Drive Motor Speed and Direction Sensor signal faults can be caused by EMI interference. In cases of intermittent trouble EMI should be considered as a possible fault condition. See Intermittents.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

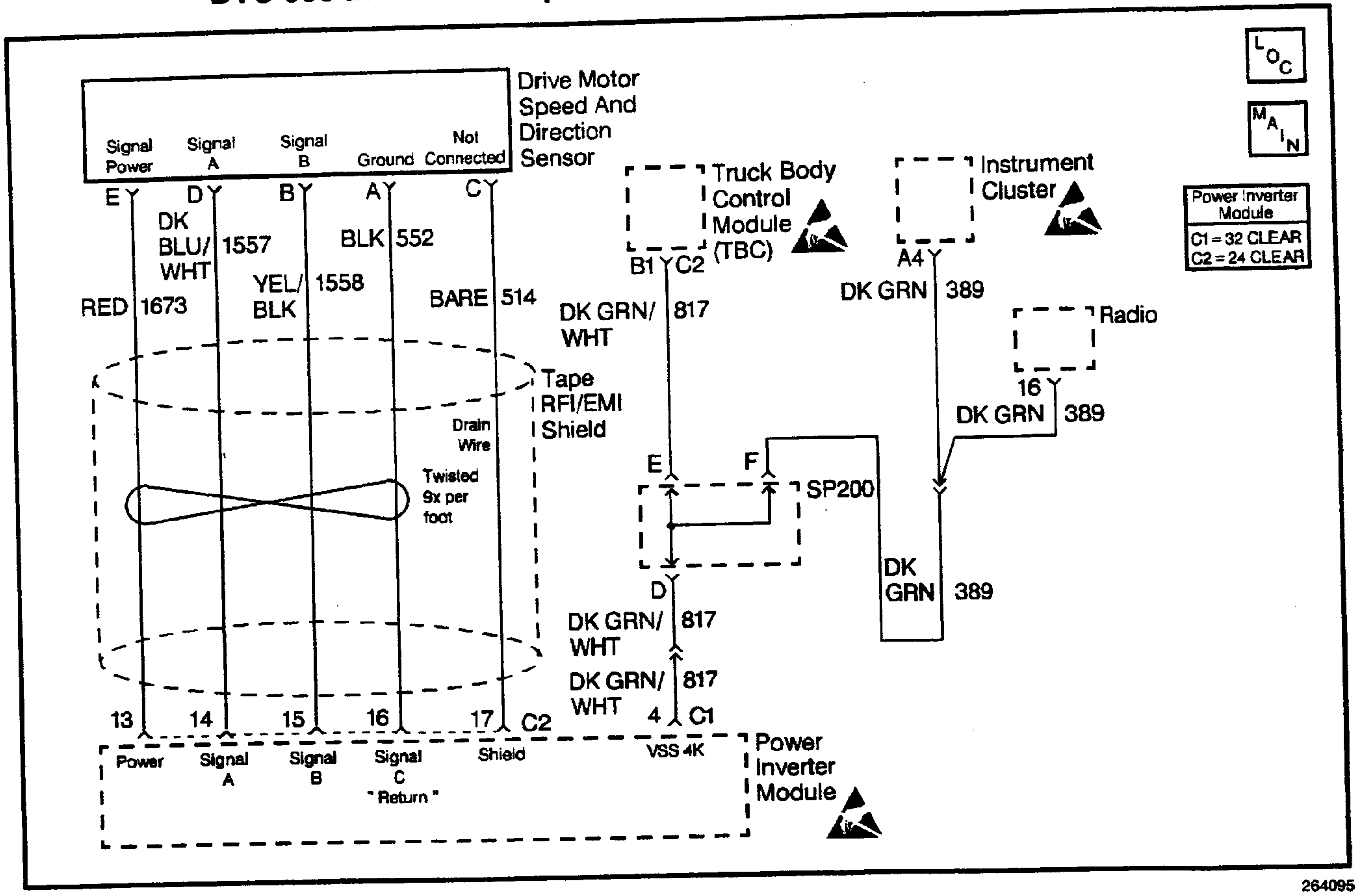
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step verifies that a problem is present.
3. This step checks the operation of the circuit from the Drive Motor Speed and Direction Sensor connector.

DTC 007 Drive Motor Speed and Direction Sensor Circuit High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Clear DTC. 2. Drive the vehicle. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Remove the connector at the Drive Motor Speed and Direction Sensor. 2. Connect the Forward/Reverse Signal Generator J 42241. 3. Send forward signal to the Power Inverter Module. 4. With the scan tool view Drive Motor Speed. Does the scan tool display Drive Motor Speed At the specified value?	4,200 RPM ± 500 RPM	Go to Step 4	Go to Step 5
4	Replace the Drive Motor Speed and Direction Sensor. Refer To *Drive Motor Speed and Direction Sensor Removal and Installation procedure.* Is the action complete?	—	Go to Step 6	—
5	Replace the Drive Motor Control Module. Refer To Power Inverter Module Assembly Removal and Installation. Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD system check*	—

DTC 008 Drive Motor Speed and Direction Sensor Performance


LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Drive Motor Speed And Direction Sensor
Signal Power
Signal A
Signal B
Ground
Not Connected
E
D
B
A
C
RED 1673
DK BLU/WHT 1557
YEL/BLK 1558
BLK 552
BARE 514
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
Truck Body Control Module (TBC)
B1
C2
DK GRN/WHT 817
Instrument Cluster
A4
DK GRN 389
Radio
16
DK GRN 389
E
F
SP200
D
DK GRN 389
DK GRN/WHT 817
DK GRN/WHT 817
4
C1
13
14
15
16
17
C2
Power
Signal A
Signal B
Signal C "Return"
Shield
VSS 4K
Power Inverter Module
264095

Circuit Description

The Drive Motor Control Module uses and monitors the shaft speed signal for several different functions including vehicle speed, torque control, and cruise control. The Bias Control Assembly generates the Drive Motor Speed and Direction Sensor signal which has 1 pulse for every 1 pulses of the shaft Drive Motor Speed and Direction Sensor signal. The Drive Motor Speed and Direction Sensor is located in the left hand side of the Drive Motor.

Conditions for Setting the DTC

- The automatic disconnect is closed.
- Drive Motor Control Module detects 2000 RPM change in shaft speed from the Drive Motor Speed and Direction Sensor frequency within 7.8 milliseconds.
- Shaft direction changes are detected while shaft speed is greater than 2000 RPM.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE SOON light.
- DTC will be stored in failure records buffer.
- Regeneration is disabled.
- Cruise control is disabled.

Conditions for Clearing the DTC

- If the fault clears for 2 minutes the Drive Motor Control Module will turn off the SERVICE SOON light and the vehicle will return to normal operation.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Drive Motor Speed and Direction Sensor signal faults can be caused by EMI interference. In cases of intermittent trouble EMI should be considered as a possible fault condition. Check the condition of the harness between the drive motor speed and direction sensor and the power inverter module.
- Check the drive motor ground strap.
- If the problem is intermittent send a forward signal to the power inverter module and wiggle the speed and direction sensor harness while viewing the scan tool.
- Review Drive Motor Control Module DTC(s) 043, 076, 079, and 080.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

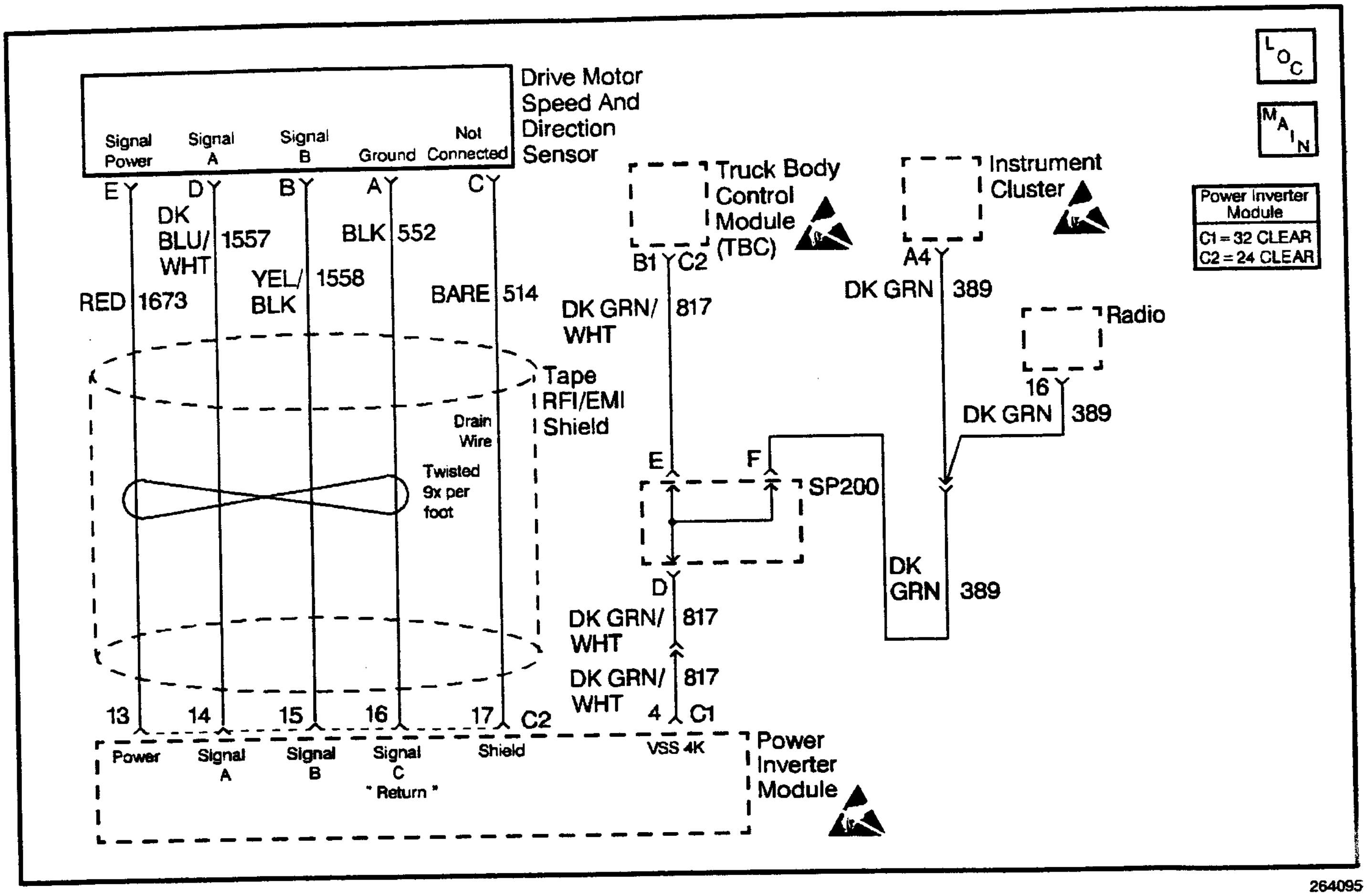
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step verifies that a problem is present.
4. This step checks the operation of the Drive Motor Speed and Direction Sensor circuit from the Drive Motor Speed and Direction Sensor connector.

DTC 008 Drive Motor Speed and Direction Sensor Performance

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any other Drive Motor Speed and Direction Sensor DTC(s) set?	—	Go to other DTCs first	Go to Step 3
3	1. Using a scan tool capture the failure records 2. Clear DTC. 3. Drive the vehicle. Did the DTC reset?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Remove the connector at the Drive Motor Shaft Speed and Direction Sensor. 2. Connect the Forward/Reverse Signal Generator J 42241. 3. Send forward signal to the Power Inverter Module. 4. With the scan tool view Drive Motor Shaft Speed. Does the scan tool display Drive Motor Shaft Speed At the specified value?	4,200 RPM ± 500 RPM	Go to Step 5	Go to Step 6
5	Replace the Drive Motor Speed and Direction Sensor. Refer To *Drive Motor Speed Sensor Removal and Installation procedure.* Is the action complete?	—	Go to Step 7	—
6	Replace the Power Inverter Module. Refer To Power Inverter Module Assembly Removal and Installation. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 009 Drive Motor Speed and Direction Sensor Circuit Low


Drive Motor Speed And Direction Sensor
Signal Power
Signal A
Signal B
Ground
Not Connected
E
D
B
A
C
RED 1673
DK BLU/WHT 1557
YEL/BLK 1558
BLK 552
BARE 514
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
Truck Body Control Module (TBC)
B1
C2
DK GRN/WHT 817
Instrument Cluster
A4
DK GRN 389
Radio
16
DK GRN 389
E
F
SP200
D
DK GRN/WHT 817
DK GRN 389
DK GRN/WHT 817
4
C1
13
14
15
16
17
C2
Power
Signal A
Signal B
Signal C "Return"
Shield
VSS 4K
Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
264095

Circuit Description

The Drive Motor Control Module uses and monitors the shaft speed signal for several different functions including vehicle speed, torque control, and cruise control. The Bias Control Assembly generates the Drive Motor Shaft Speed Direction signal which has 1 pulse for every 1 pulses of the shaft Drive Motor Speed and Direction Sensor signal. The Drive Motor Speed and Direction Sensor is located in the left hand side of the Drive Motor.

Conditions for Setting the DTC

The DTC will set when the following conditions are present for 2 seconds.

- The Drive Motor Control Module is commanding more than 30 amps of motor current.
- The Drive Motor Speed and Direction Sensor input indicates zero speed (no transitions).
- No feed back is present on the motor phase current feedback signal.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE NOW light
- DTC will be stored in failure records buffer
- Propulsion is disabled
- Regeneration is disabled
- Cruise control is disabled

Conditions for Clearing the DTC

- The SERVICE NOW light will be turned OFF after 30 seconds of no fault condition. Propulsion, regeneration and cruise control will then be re-enabled.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

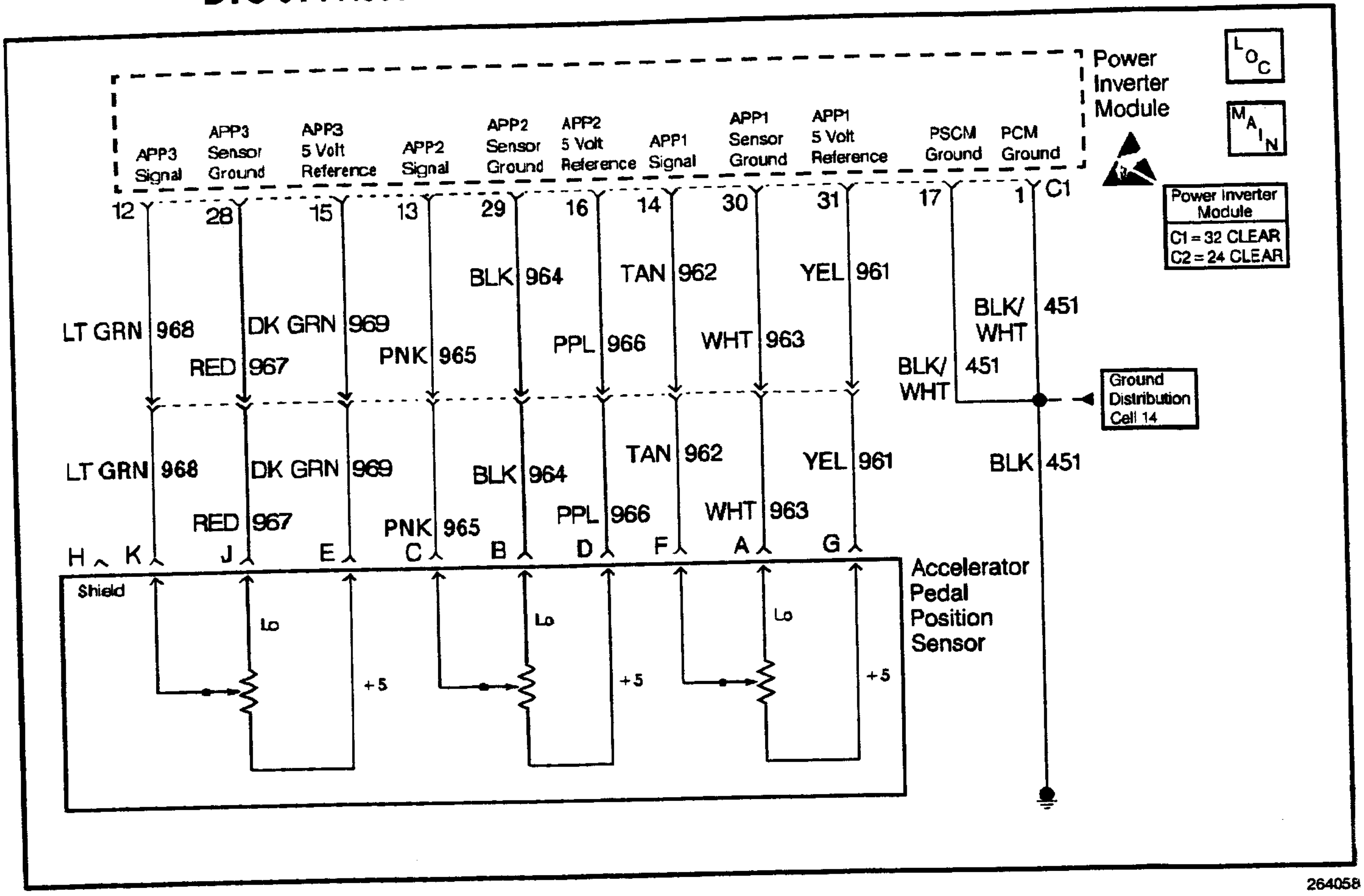
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for power to the sensor.
3. Checks for a good ground.
4. Checks the entire circuit and Power Inverter Module operation.

DTC 009 Drive Motor Speed and Direction Sensor Circuit Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Remove the Drive Motor Speed and Direction Sensor connector. 2. Using a DMM, check circuit 1673 for voltage. Is the voltage at or above the specified value?	12 V	Go to Step 3	Go to Step 7
3	Using a test light connected to 12 volts, probe ground circuit 552 at the Drive Motor Speed and Direction Sensor harness connector. Did the test light turn ON?	—	Go to Step 4	Go to Step 7
4	1. Connect the drive motor Forward/Reverse Signal Generator J 42241. 2. Move the selector switch to the forward position. 3. Using the scan tool check for forward vehicle speed. Does the scan tool display vehicle speed at the specified value?	30±3 mph	Go to Step 8	Go to Step 5
5	Disconnect the Power Inverter Module 24-way connector and check signal A and signal B circuits for an open or a short to ground. Was the problem found?	—	Go to Step 7	Go to Step 6
6	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation* procedure. Is the repair complete?	—	Go to Step 9	—
7	Repair the open or short to ground in the Power Inverter Module Speed and Direction Sensor Circuit. Refer to *Electrical Diagnosis.* Is the repair complete?	—	Go to Step 9	—
8	Replace the Drive Motor Speed and Direction Sensor. Refer to *Drive Motor Speed and Direction Sensor Removal and Installation* procedure. Is the action complete?	—	Go to Step 9	—
9	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 014 Accelerator Pedal Position (APP) Sensor 1 Circuit Low


Power Inverter Module
LOC
MAIN
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
12
28
15
13
29
16
14
30
31
17
1
C1
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
BLK/WHT 451
Ground Distribution Cell 14
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Lo
+5
Lo
+5
Accelerator Pedal Position Sensor
264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 3.5 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 1.5 volts at WOT. Sensor 3 varies from 3.9 volts at closed position to about 2.2 volts at wide open throttle.

Conditions for Setting the DTC

- Key ON.
- APP 1 input voltage is less than .23 volts.
- Conditions met for 16 milliseconds.

Action Taken When the DTC Sets

- The input from APP 1 sensor is ignored.
- A current and history DTC will set but it will not turn on the SERVICE SOON lamp.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion.

Conditions for Clearing the MIL/DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

The scan tool reads APP 1 position in volts and percent. APP 1 should read from .45 to .95 volts with throttle closed and ignition ON. Voltage should increase at a steady rate as throttle is moved toward Wide Open Throttle. Also, 90% pedal travel is acceptable for correct APP operation. Scan APP sensor while depressing accelerator pedal with ignition ON and selector in Park. The display should vary from about .74 volt when throttle is closed to approximately 3.5 volts when throttle is held at Wide Open Throttle position. A DTC 014 will result if the signal or reference circuit are open.

- The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.
- All three sensors have five volt sources which are independent. Pedal position sensors 2 and 3 are inverted of actual reading 0 = 5 volts.
- If the problem is intermittent wiggle the wiring harness while viewing the scan tool and see if the value changes or the DTC sets.
- Check the tightness of the female terminal with a spare male terminal.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table.

2. This Step determines if DTC is the result of a hard failure or an intermittent condition.
4. This Step checks the Drive Motor Control Module and wiring.

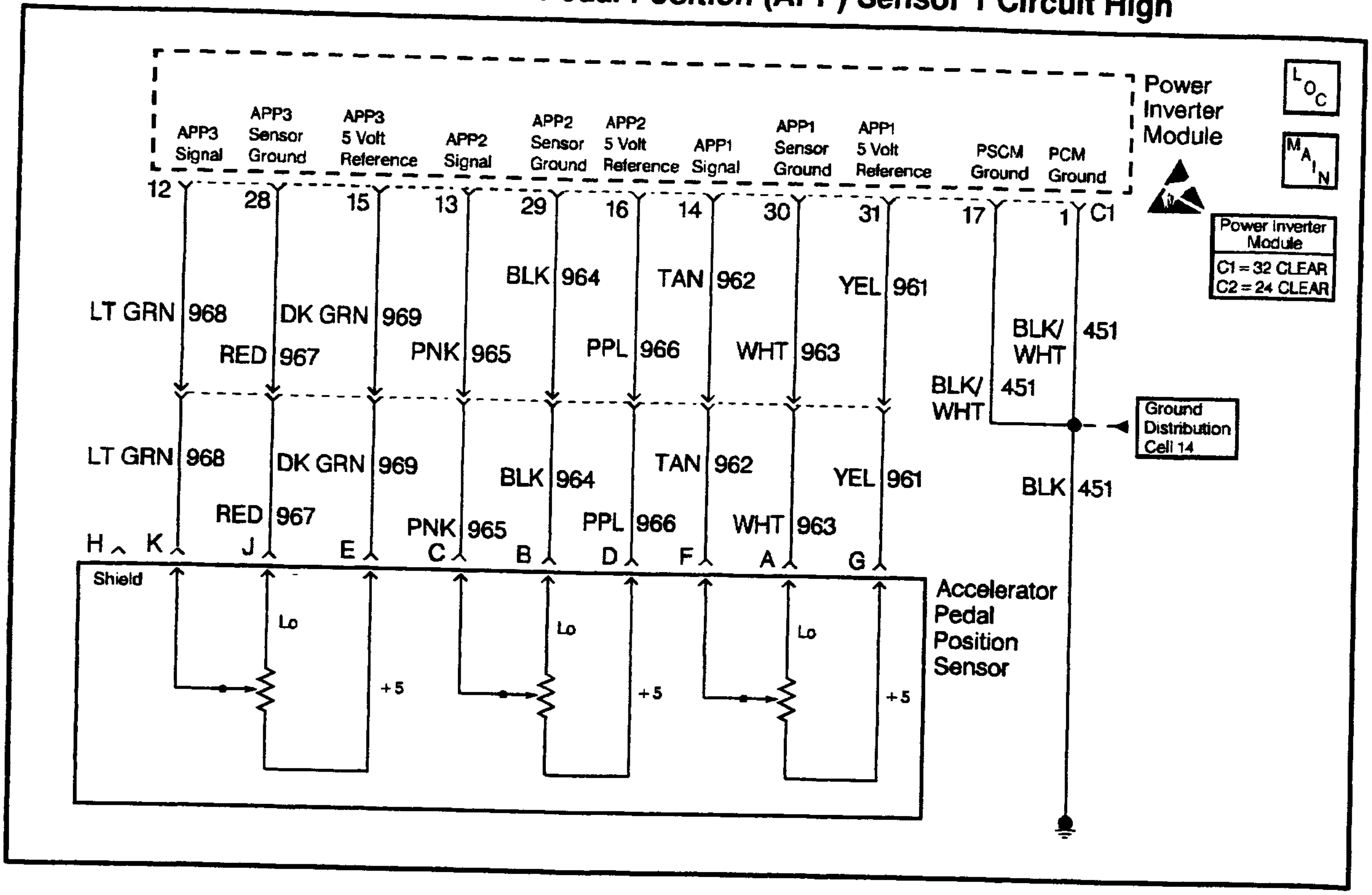
DTC 014 Accelerator Pedal Position (APP) Sensor 1 Circuit Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition ON. 2. With the accelerator pedal released, observe the APP1 voltage on the Scan Tool. Is APP1 voltage less than or equal to the specified value?	.23V	Go to Step 4	Go to Step 3
3	DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those tables(s) first. Are additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Jumper APP1, 5 volt reference circuit and the APP1 signal together at the APP sensor harness connector. 3. Observe the APP1 voltage on the Scan Tool. Is APP1 voltage greater than the specified value?	4 V	Go to Step 10	Go to Step 5
5	1. Connect a test light between B+ and the APP1 sensor signal circuit at the APP sensor harness connector. 2. Observe the APP1 voltage on the Scan Tool. Is APP1 voltage greater than the specified value?	4 V	Go to Step 6	Go to Step 8
6	1. Turn the Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference circuit open or shorted to ground?	—	Go to Step 12	Go to Step 7

DTC 014 Accelerator Pedal Position (APP) Sensor 1 Circuit Low (continued)

Step	Action	Value(s)	Yes	No
7	Check the 5 volt reference circuit for a poor connection at the Power Inverter Module 32-way connector and replace terminal if necessary. Did the terminal require replacement?	—	Go to Step 12	Go to Step 11
8	1. Turn the Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector, and check the APP1 signal circuit for an open, short to ground. 3. If the APP1 sensor signal circuit is open or shorted to ground, repair it as necessary. Was the APP1 signal circuit open or shorted to ground?	—	Go to Step 12	Go to Step 9
9	Check the APP1 sensor signal circuit for a poor connection at the Power Inverter Module 32-way connector and replace terminal if necessary. Did the terminal require replacement?	—	Go to Step 12	Go to Step 11
10	Replace the APP module. Refer to: *APP removal and replacement procedure.* Is the action complete?	—	Go to Step 12	—
11	Replace the Power Inverter Module. Refer to Power Inverter Module replacement procedures. Is the action complete?	—	Go to Step 12	—
12	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 015 Accelerator Pedal Position (APP) Sensor 1 Circuit High


APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
12
28
15
13
29
16
14
30
31
17
1
C1
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
BLK/WHT 451
Ground Distribution Cell 14
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Accelerator Pedal Position Sensor

264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 3.5 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 1.5 volts at WOT. Sensor 3 varies from 3.9 volts at closed position to about 2.2 volts at wide open throttle.

Conditions for Setting the DTC

- APP 1 input voltage is greater than 4.8 volts for 16 milliseconds.

Action Taken When the DTC Sets

- The input from APP 1 sensor is ignored.
- A current and history DTC will set but it will not turn on the SERVICE SOON lamp.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion.

Conditions for Clearing the MIL/DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

A scan tool reads APP 1 position in volts. Should read about .45 to .95 volt with throttle closed and ignition ON. Voltage should increase at a steady rate as throttle is moved toward Wide Open Throttle (WOT). Also, 90% pedal travel is acceptable for correct 0 APP operation. Scan APP 1 sensor while depressing accelerator pedal with ignition ON and selector in Park. Display should vary from about .74 volt when throttle was closed to approximately 3.5 volt when throttle is held at Wide Open Throttle (WOT) position. A DTC 015 will result if the ground circuit is open or the signal circuit is shorted to voltage. Refer to *Intermittent in Symptoms*

- The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.
- All three sensors have five volt sources which are independent. Pedal position sensors 2 and 3 are inverted of actual reading 0 = 5 volts.
- If the problem is intermittent wiggle the wiring harness while viewing the scan tool and see if the value changes or the DTC sets.
- Check the tightness of the female terminal with a spare male terminal.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Test Description

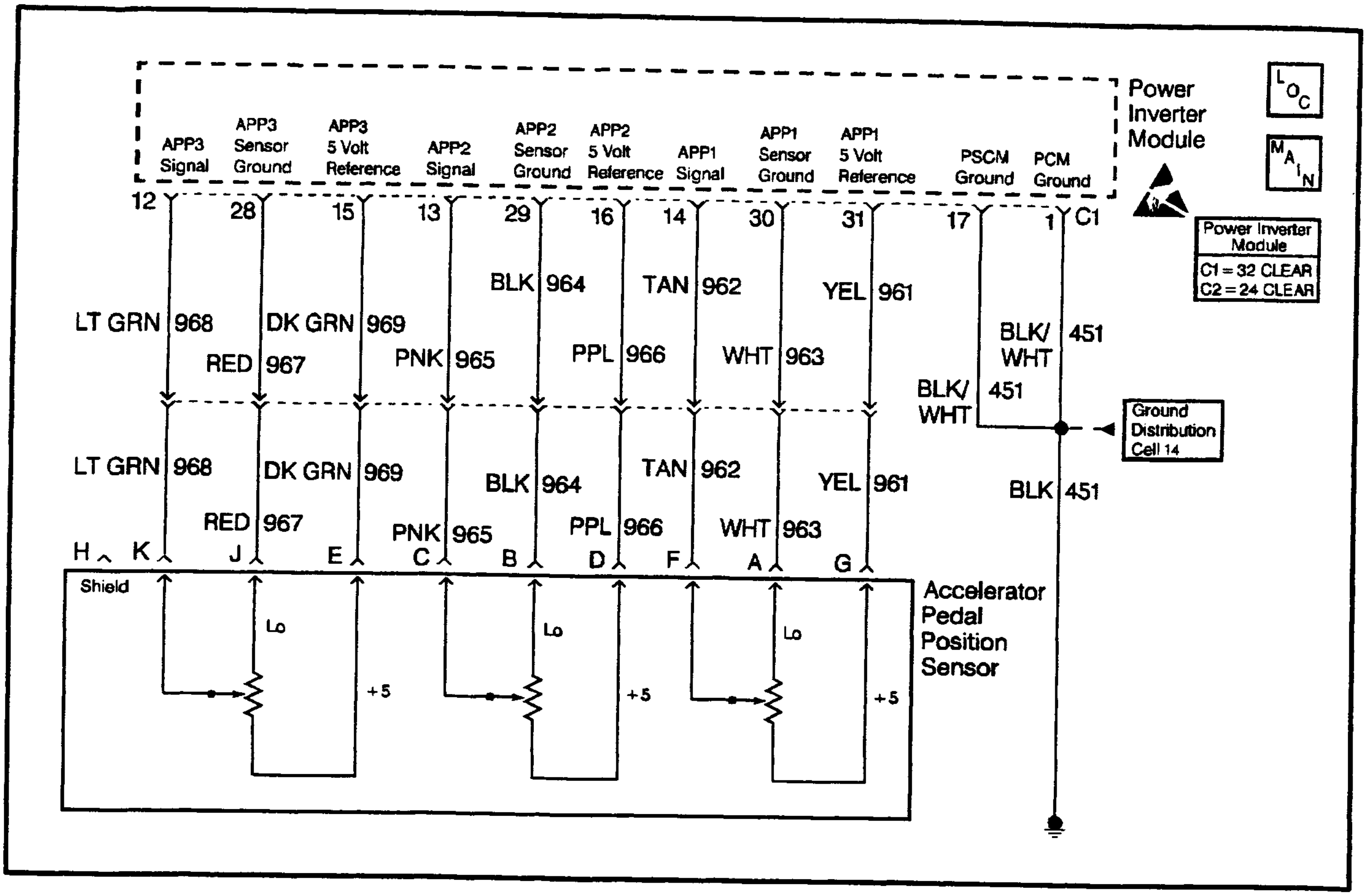
Number(s) below refer to the Step number(s) on the Diagnostic Table.

2. This Step determines if DTC is the result of a hard failure or an intermittent condition.
4. This Step checks the Drive Motor Control Module and wiring.

DTC 015 Accelerator Pedal Position (APP) Sensor 1 Circuit High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition ON. 2. With the accelerator pedal released, observe the APP1 display on the scan tool. Is APP1 above the specified value?	4.6V	Go to Step 4	Go to Step 3
3	DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are additional DTC(s) stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Observe the APP1 display on the scan tool. Is APP1 less than the specified value?	.25V	Go to Step 5	Go to Step 6
5	Probe APP1 sensor ground circuit at the APP sensor harness connector with a test light connected to B+. Is the test light ON?	—	Go to Step 7	Go to Step 8
6	1. Check for a short to voltage on the APP1 sensor signal circuit. 2. If the APP1 sensor signal circuit is shorted, repair it as necessary. Was the APP1 sensor signal circuit shorted?	—	Go to Step 11	Go to Step 10
7	Check for poor electrical connections at the APP sensor and replace terminals if necessary Did any terminals require replacement?	—	Go to Step 11	Go to Step 9
8	1. Check for an open sensor ground circuit. 2. If a problem is found, repair it as necessary. Was APP1 sensor ground circuit open?	—	Go to Step 11	Go to Step 10
9	Replace the APP module. Refer to: *APP removal and replacement procedure.* Is the action complete?	—	Go to Step 11	—
10	Replace the Power Inverter Module. Refer to Power Inverter Module replacement procedures. Is the action complete?	—	Go to Step 11	—
11	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 016 Accelerator Pedal Position (APP) Sensor 1 Circuit Performance


Power Inverter Module
LOC
MAIN
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
12
28
15
13
29
16
14
30
31
17
1
C1
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
BLK/WHT 451
Ground Distribution Cell 14
BLK 451
H K J E C B D F A G
Shield
Lo
+5
Lo
+5
Lo
+5
Accelerator Pedal Position Sensor
264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 3.5 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 1.5 volts at WOT. Sensor 3 varies from 3.9 volts at closed position to about 2.2 volts at wide open throttle.

Conditions for Setting the DTC

- APP1 sensor input voltage changes more than 2.5 volts in 16 milliseconds.

Action Taken When the DTC Sets

- The input from APP1 sensor is ignored.
- A current and history DTC will set but it will not turn on the SERVICE SOON lamp.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion.

Conditions for Clearing the MIL/DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

A scan tool reads APP1 position in volts. It should read about .45 to .95 volt with throttle closed and ignition ON. Voltage should increase at a steady rate as throttle is moved toward Wide Open Throttle (WOT). Also, 90% pedal travel is acceptable for correct APP operation. Scan APP1 sensor while depressing accelerator pedal with ignition ON. Display should vary from about .74 volt when throttle was closed to over approximately 3.5 volts when throttle is held at Wide Open Throttle (WOT) position. The following chart will check voltages on all APP circuits to see if they fall in normal ranges. The Drive Motor Control Module compares pre-scaled voltages (these are voltages that the scan tool cant read). The scan tool reads only output voltages.

- The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.
- All three sensors have five volt sources which are independent. Pedal position sensors 2 and 3 are inverted of actual reading 0 = 5 volts.
- If the problem is intermittent wiggle the wiring harness while viewing the scan tool and see if the value changes or the DTC sets.
- Check the tightness of the female terminal with a spare male terminal.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table.

4. This Step determines if there is a good 5 volt reference.
5. This Step will check for an open in the ground circuit.

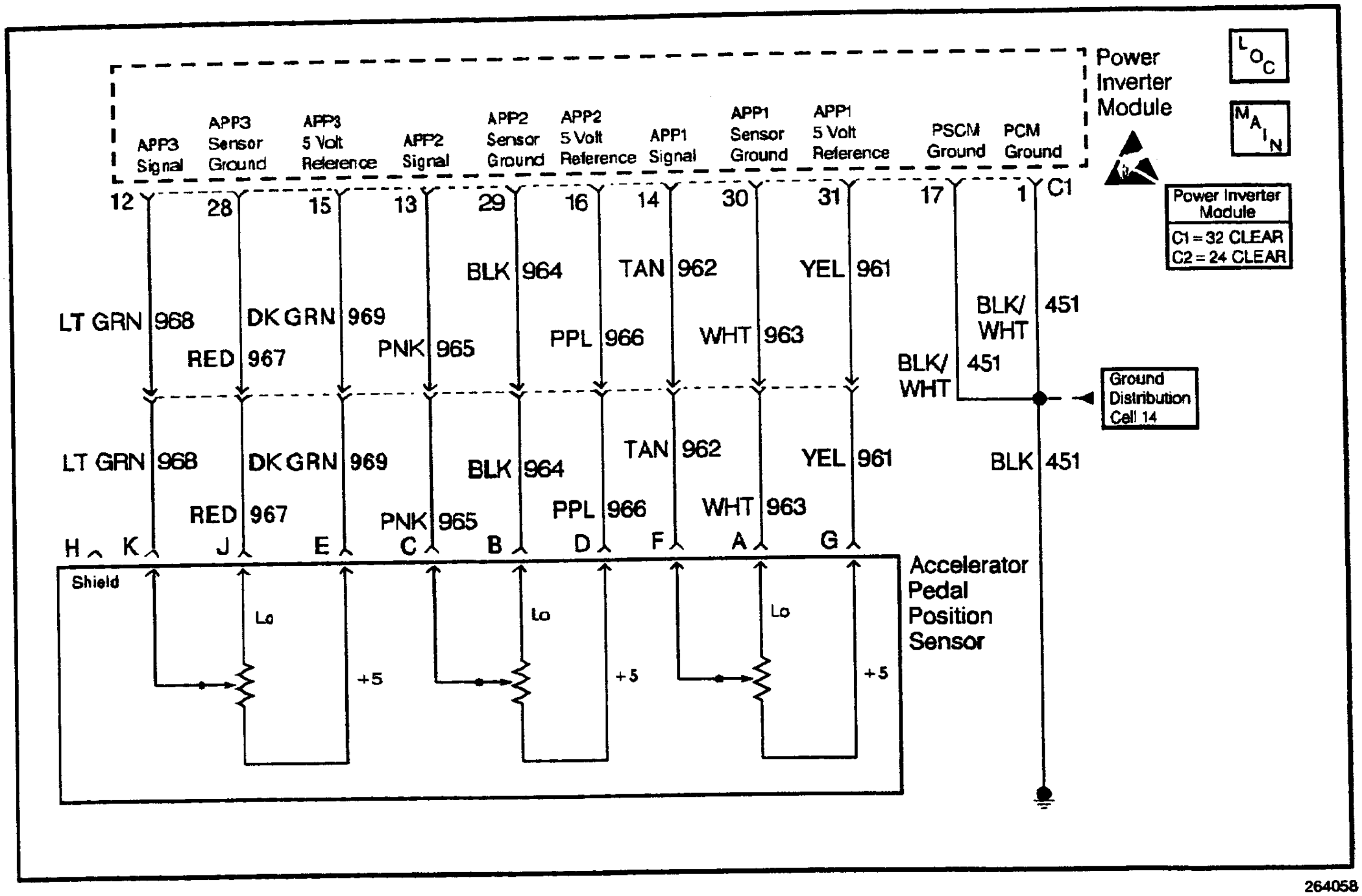
DTC 016 Accelerator Pedal Position (APP) Sensor 1 Circuit Performance

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition ON. 2. With the accelerator pedal released, observe APP1, APP2, and APP3 voltages on the scan tool. Are APP voltages at specified values?	.45-.95V 4.0-4.5V 3.6-4.1V	Go to Step 3	Go to Step 4
3	DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are additional DTC(s) stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Ignition ON. 3. With J 39200 DMM connected to ground, probe APP sensor 5 volt reference circuits at APP harness terminals G, D and E. Is voltage at the specified value on all circuits?	4.75V	Go to Step 5	Go to Step 6
5	1. Turn the Ignition ON. 2. With a test light connected to B+, probe APP sensor ground circuits at the APP sensor harness terminals A, B and J. Is Test light ON (all circuits)?	—	Go to Step 9	Go to Step 8
6	1. Turn the Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference circuit open or shorted to ground?	—	Go to Step 11	Go to Step 7

DTC 016 Accelerator Pedal Position (APP) Sensor 1 Circuit Performance (continued)

Step	Action	Value(s)	Yes	No
7	Check the 5 volt reference circuit for a poor connection at the Power Inverter Module 32-way connector and replace terminal if necessary. Did the terminal require replacement?	—	Go to Step 11	Go to Step 10
8	1. Turn the Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector and check for an open sensor ground circuit. 3. If problem is found, repair as necessary. Was APP sensor ground circuit open?	—	Go to Step 11	Go to Step 10.
9	Replace the APP module. Refer to: *APP removal and replacement procedure.* Is the action complete?	—	Go to Step 11	—
10	Replace the faulty Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 11	—
11	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 017 Accelerator Pedal Position (APP) Sensor 2 Circuit Low


Power Inverter Module
LOC
MAIN
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
12 28 15 13 29 16 14 30 31 17 1 C1
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
BLK/WHT 451
Ground Distribution Cell 14
BLK 451
H K J E C B D F A G
Shield
Lo
+5
Lo
+5
Lo
+5
Accelerator Pedal Position Sensor
264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 3.5 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 1.5 volts at WOT. Sensor 3 varies from 3.9 volts at closed position to about 2.2 volts at wide open throttle.

Conditions for Setting the DTC

- Voltage is less than 0.27 volt on APP2 sensor.
- Condition met for 16 milliseconds

Action Taken When the DTC Sets

- The input from APP 2 sensor is ignored.
- A current and history DTC will set but it will not turn on the SERVICE SOON lamp.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion.

Conditions for Clearing the MIL/DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

A scan tool reads APP 2 position in volts and should read about 4.5 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward WOT. Refer to *Intermittent*. Scan APP2 sensor while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about 4.5 volts when throttle was closed to about 1.5 volts when throttle is held at Wide Open Throttle (WOT) position.

- The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.
- All three sensors have five volt sources which are independent. Pedal position sensors 2 and 3 are inverted of actual reading 0 = 5 volts.
- If the problem is intermittent wiggle the wiring harness while viewing the scan tool and see if the value changes or the DTC sets.
- Check the tightness of the female terminal with a spare male terminal.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table.

2. This Step determines if 017 is the result of a hard failure or an intermittent condition.
3. This Step checks the Drive Motor Control Module and wiring.

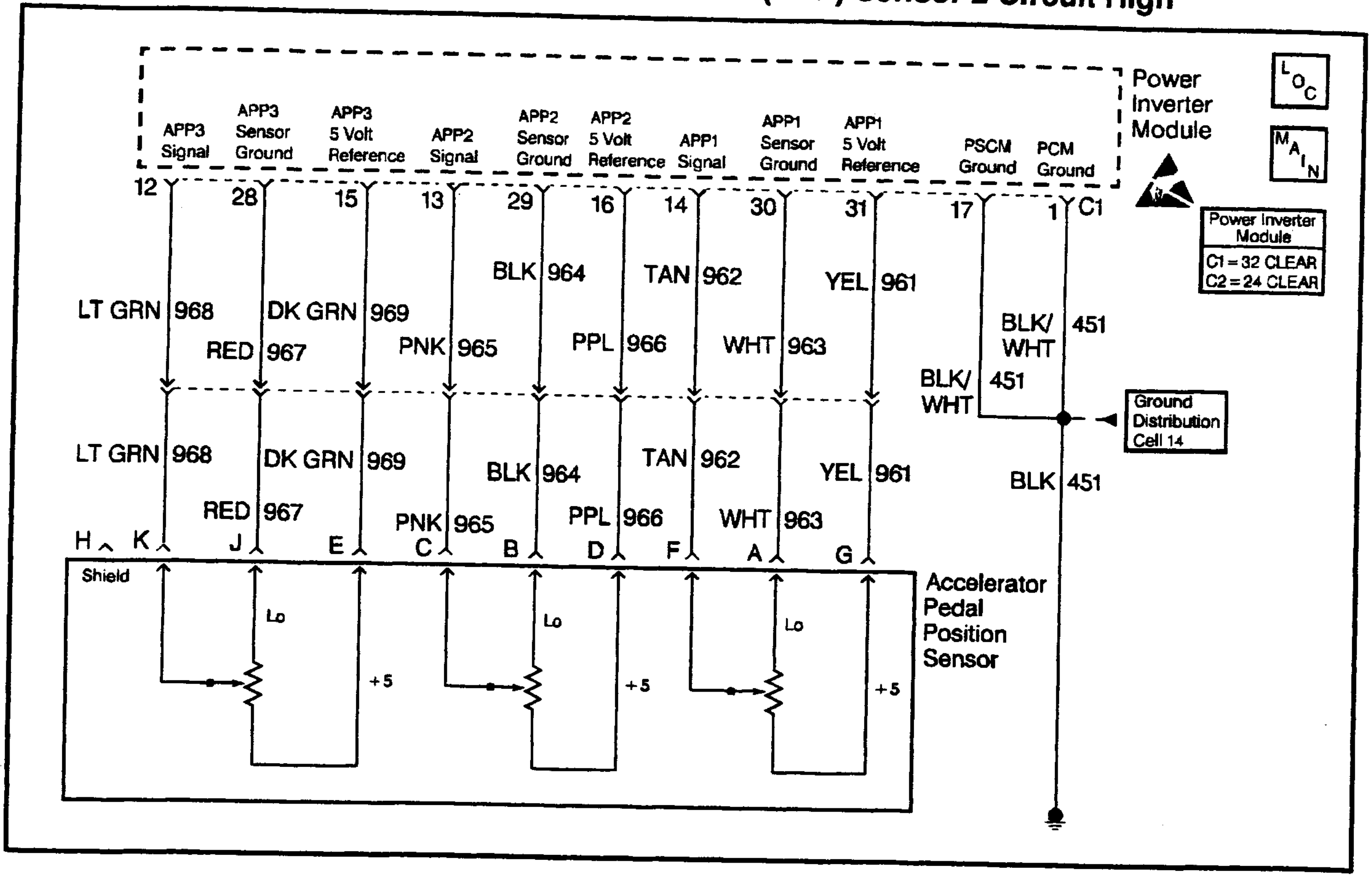
DTC 017 Accelerator Pedal Position (APP) Sensor 2 Circuit Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition ON,. 2. With the accelerator pedal released, observe the APP2 voltage on the Scan Tool. Is APP2 voltage less than or equal to the specified value?	.23V	Go to Step 4	Go to Step 3
3	DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those tables(s) first. Are additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Jumper APP2, 5 volt reference circuit and the APP2 signal together at the APP sensor harness connector. 3. Observe the APP2 voltage on the Scan Tool. Is APP2 voltage greater than the specified value?	4 V	Go to Step 10	Go to Step 5
5	1. Connect a test light between B+ and the APP2 sensor signal circuit at the APP sensor harness connector. 2. Observe the APP2 voltage on the Scan Tool. Is APP2 voltage greater than the specified value?	4 V	Go to Step 6	Go to Step 8
6	1. Turn the Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector, and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference circuit open or shorted to ground?	—	Go to Step 12	Go to Step 7
7	Check the 5 volt reference circuit for a poor connection at the Power Inverter Module 32-way connector and replace terminal if necessary. Did the terminal require replacement?	—	Go to Step 12	Go to Step 11

DTC 017 Accelerator Pedal Position (APP) Sensor 2 Circuit Low (continued)

Step	Action	Value(s)	Yes	No
8	1. Turn the Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector, and check the APP2 signal circuit for an open, short to ground. 3. If the APP2 sensor signal circuit is open or shorted to ground, repair it as necessary. Was the APP2 signal circuit open or shorted to ground?	—	Go to Step 12	Go to Step 9
9	Check the APP2 sensor signal circuit for a poor connection at the Power Inverter Module 32-way connector and replace terminal if necessary. Did the terminal require replacement?	—	Go to Step 12	Go to Step 11
10	Replace the APP module. Refer to *APP removal and replacement procedure.* Is the action complete?	—	Go to Step 12	—
11	Replace the faulty Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 12	—
12	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 018 Accelerator Pedal Position (APP) Sensor 2 Circuit High


Power Inverter Module
LOC
MAIN
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
12
28
15
13
29
16
14
30
31
17
1
C1
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
BLK/WHT 451
Ground Distribution Cell 14
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Lo
+5
Lo
+5
Accelerator Pedal Position Sensor
264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 3.5 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 1.5 volts at WOT. Sensor 3 varies from 3.9 volts at closed position to about 2.2 volts at wide open throttle.

Conditions for Setting the DTC

- Input voltage is greater than 4.8 volts on APP2.
- Condition met for 16 milliseconds.

Action Taken When the DTC Sets

- The input from APP2 sensor is ignored.
- A current and history DTC will set but it will not turn on the SERVICE SOON lamp.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

A Scan tool reads APP 2 position in volts and should read about 4.5 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward WOT. Also, 90% pedal travel is acceptable for correct APP operation. Refer to *Symptoms for Intermittent*. Scan APP2 signal while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about 4.5 volts when throttle was closed to about 1.5 volts when throttle is held at Wide Open Throttle (WOT) position. Its possible P1125 will set along with DTC 018 if the signal circuit is open.

The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.

- All three sensors have five volt sources which are independent. Pedal position sensors 2 and 3 are inverted of actual reading 0 = 5 volts.
- If the problem is intermittent wiggle the wiring harness while viewing the scan tool and see if the value changes or the DTC sets.
- Check the tightness of the female terminal with a spare male terminal.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Test Description

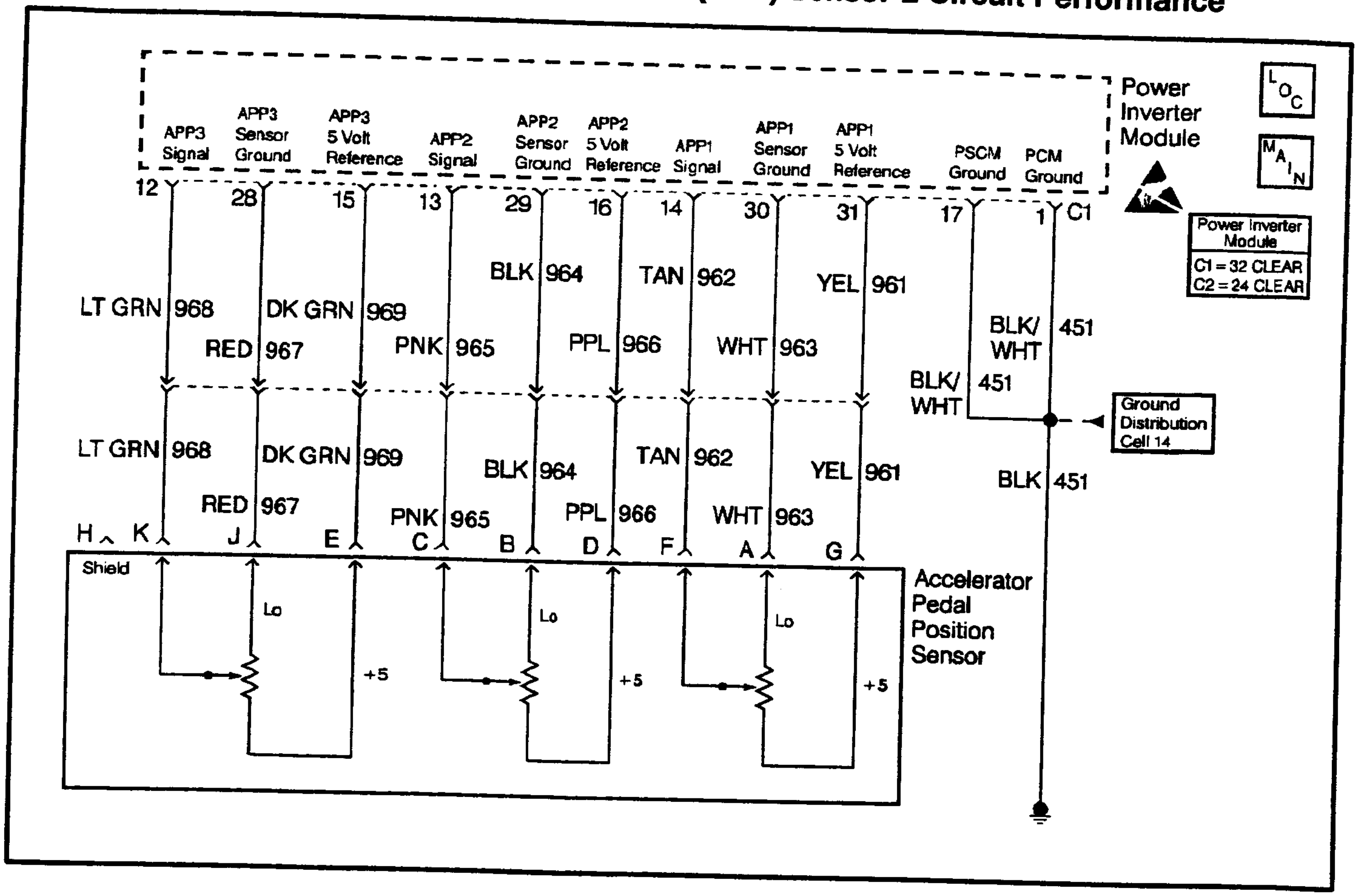
Number(s) below refer to the Step number(s) on the Diagnostic Table.

2. This Step determines if 018 is a hard failure or an intermittent condition.
5. This Step will check for an open in the ground circuit.

DTC 018 Accelerator Pedal Position (APP) Sensor 2 Circuit High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition ON. 2. With the accelerator pedal released, observe the APP2 display on the scan tool. Is APP2 above the specified value?	4.6V	Go to Step 4	Go to Step 3
3	DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to *the* applicable DTC table(s) first. Are additional DTC(s) stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Observe the APP2 display on the scan tool. Is APP2 less than the specified value?	.25V	Go to Step 5	Go to Step 6
5	Probe APP2 sensor ground circuit at the APP sensor harness connector with a test light connected to B+. Is the test light ON?	—	Go to Step 7	Go to Step 8
6	1. Check for a short to voltage on the APP2 sensor signal circuit. 2. If the APP2 sensor signal circuit is shorted, repair it as necessary. Was the APP2 sensor signal circuit shorted?	—	Go to Step 11	Go to Step 10
7	Check for poor electrical connections at the APP sensor and replace terminals if necessary Did any terminals require replacement?	—	Go to Step 11	Go to Step 9
8	1. Check for an open sensor ground circuit. 2. If a problem is found, repair it as necessary. Was APP2 sensor ground circuit open?	—	Go to Step 11	Go to Step 10
9	Replace the APP module. Refer to: *APP removal and replacement procedure.* Is the action complete?	—	Go to Step 11	—
10	Replace the faulty Power Inverter Module. Refer to: Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 11	—
11	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 019 Accelerator Pedal Position (APP) Sensor 2 Circuit Performance


Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
12
28
15
13
29
16
14
30
31
17
1
C1
LT GRN 968
DK GRN 969
RED 967
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
BLK 451
Ground Distribution Cell 14
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Accelerator Pedal Position Sensor

264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 3.5 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 1.5 volts at WOT. Sensor 3 varies from 3.9 volts at closed position to about 2.2 volts at wide open throttle.

Conditions for Setting the DTC

- APP2 sensor input voltage changes more than 2.5 volts in 16 milliseconds.

Action Taken When the DTC Sets

- The input from APP 2 sensor is ignored.
- A current and history DTC will set but it will not turn on the SERVICE SOON lamp.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

A scan tool reads APP 2 position in volts and should read about 4.5 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward WOT. Also, 90% pedal travel is acceptable for correct APP operation. Refer to *Intermittent.* Scan APP 2 sensor while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about 4.5 volts when throttle was closed to about 1.5 volts when throttle is held at Wide Open Throttle (WOT) position.

- The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.
- All three sensors have five volt sources which are independent. Pedal position sensors 2 and 3 are inverted of actual reading 0 = 5 volts.
- If the problem is intermittent wiggle the wiring harness while viewing the scan tool and see if the value changes or the DTC sets.
- Check the tightness of the female terminal with a spare male terminal.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table.

4. This Step determines if there is a good 5 volt reference.
5. This Step will check for an open in the ground circuit.

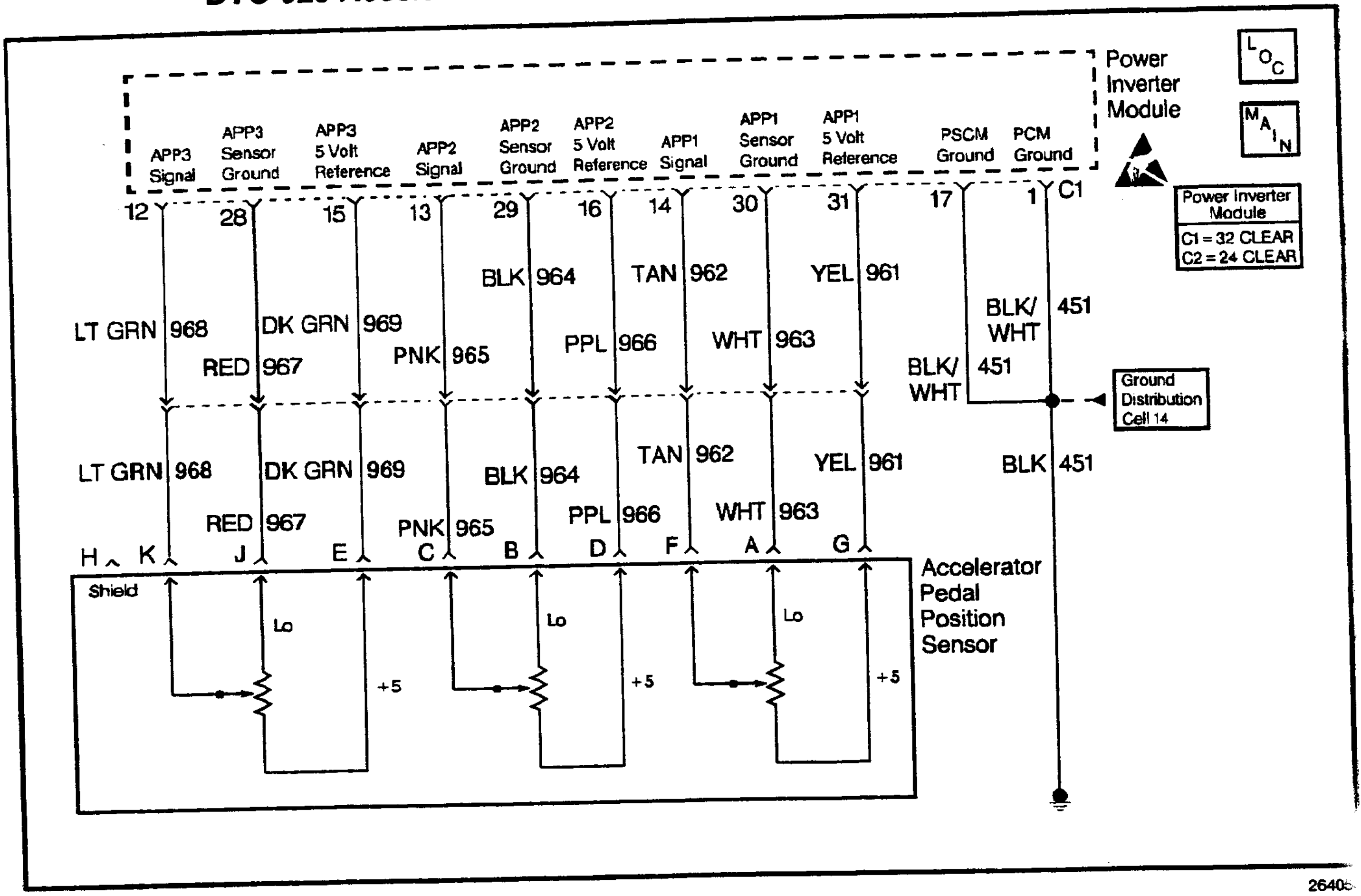
DTC 019 Accelerator Pedal Position (APP) Sensor 2 Circuit Performance

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition ON. 2. With the accelerator pedal released, observe APP1, APP2, and APP3 voltages on the scan tool. Are APP voltages at specified values?	.45-.95V 4.0-4.5V 3.6-4.1V	Go to Step 3	Go to Step 4
3	DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are additional DTC(s) stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Turn the Ignition ON. 3. With J 39200 DMM connected to ground, probe APP sensor 5 volt reference circuits at APP harness terminals G, D and E. Is voltage at the specified value on all circuits?	4.75V	Go to Step 5	Go to Step 6
5	1. Turn the Ignition ON. 2. With a test light connected to B+, probe APP sensor ground circuits at the APP sensor harness terminals A, B and J. Is Test light ON (all circuits)?	—	Go to Step 9	Go to Step 8
6	1. Turn the Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector, and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference circuit open or shorted to ground?	—	Go to Step 11	Go to Step 7
7	Check the 5 volt reference circuit for a poor connection at the Power Inverter Module 32-way connector, and replace terminal if necessary. Did the terminal require replacement?	—	Go to Step 11	Go to Step 10

DTC 019 Accelerator Pedal Position (APP) Sensor 2 Circuit Performance (continued)

Step	Action	Value(s)	Yes	No
8	1. Turn the Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector, and check for an open sensor ground circuit. 3. If problem is found, repair as necessary. Was APP sensor ground circuit open?	—	Go to Step 11	Go to Step 10.
9	Replace the APP module. Refer to *APP removal and replacement procedure.* Is the action complete?	—	Go to Step 11	—
10	Replace the faulty Power Inverter Module. Refer to: Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 11	—
11	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 020 Accelerator Pedal Position (APP) Sensor 3 Circuit Low


Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
C1
12
28
15
13
29
16
14
30
31
17
1
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/ WHT 451
BLK/ WHT 451
Ground Distribution Cell 14
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Accelerator Pedal Position Sensor
26405

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 3.5 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 1.5 volts at WOT. Sensor 3 varies from 3.9 volts at closed position to about 2.2 volts at wide open throttle.

Conditions for Setting the DTC

- Voltage is less than 1.5 volts on APP 3 sensor.
- Conditions met for 16 milliseconds.

Action Taken When the DTC Sets

- The input from APP 3 sensor is ignored.
- A current and history DTC will set but it will not turn ON the SERVICE SOON lamp.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

A scan tool reads APP 3 position in volts. Should read about 4.0 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward Wide Open Throttle (WOT) position. Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 3 sensor while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about 4.0 volts when throttle was closed to about 2.0 volts when throttle is held at Wide Open Throttle (WOT) position.

- The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.
- All three sensors have five volt sources which are independent. Pedal position sensors 2 and 3 are inverted of actual reading 0 = 5 volts.
- If the problem is intermittent wiggle the wiring harness while viewing the scan tool and see if the value changes or the DTC sets.
- Check the tightness of the female terminal with a spare male terminal.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table.

2. This Step will determine if DTC 020 is the result of a hard failure or an intermittent condition.
4. This Step checks the Drive Motor Control Module and wiring.

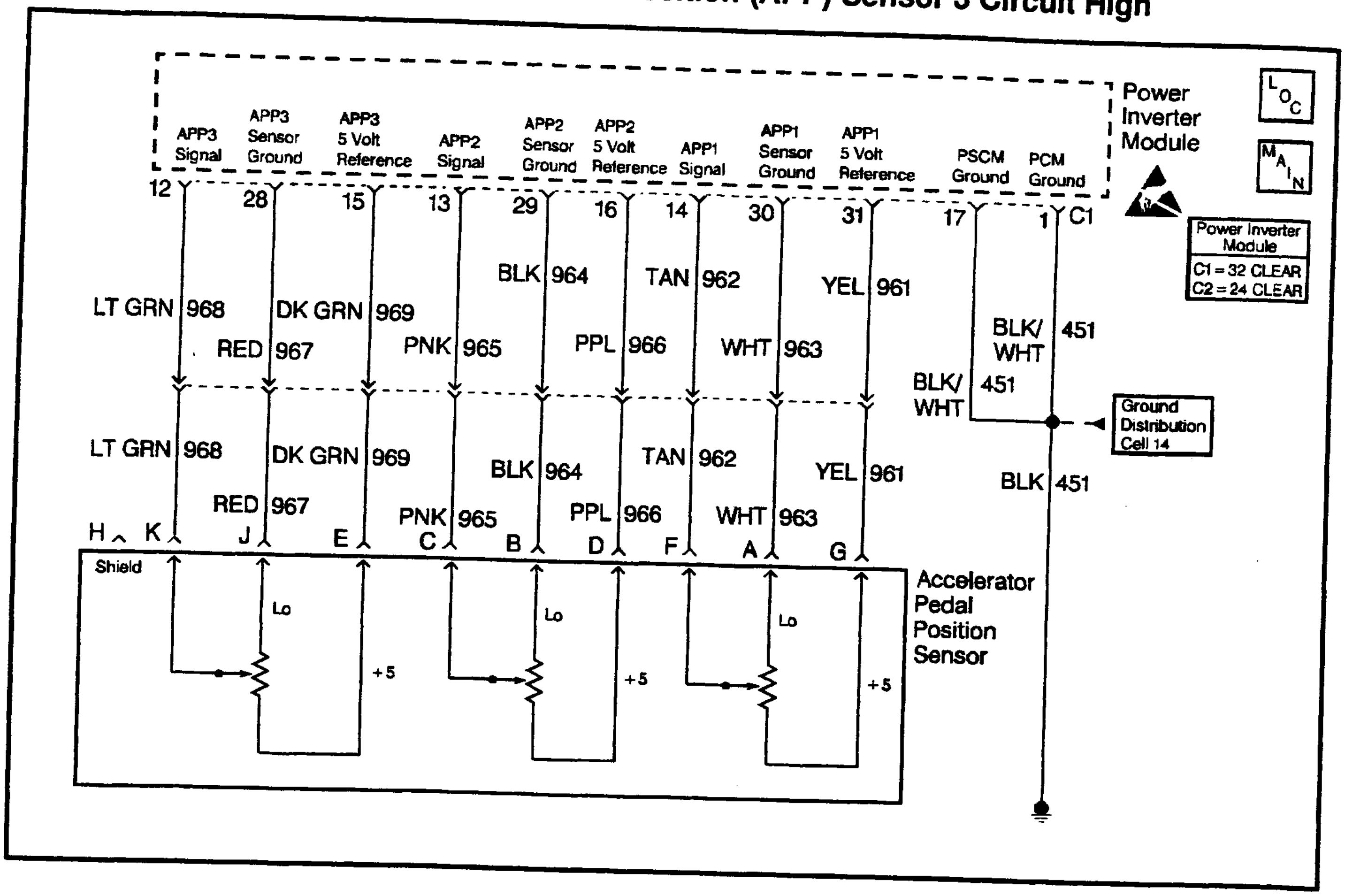
DTC 020 Accelerator Pedal Position (APP) Sensor 3 Circuit Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition ON. 2. With the accelerator pedal released, observe the APP3 voltage on the Scan Tool. Is APP3 voltage less than or equal to the specified value?	1.3V	Go to Step 4	Go to Step 3
3	DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to those tables(s) first. Are additional DTCs stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Jumper APP3, 5 volt reference circuit and the APP3 signal together at the APP sensor harness connector. 3. Observe the APP3 voltage on the Scan Tool. Is APP3 voltage greater than the specified value?	4 V	Go to Step 10	Go to Step 5
5	1. Connect a test light between B+ and the APP3 sensor signal circuit at the APP sensor harness connector. 2. Observe the APP3 voltage on the Scan Tool. Is APP3 voltage greater than the specified value?	4 V	Go to Step 6	Go to Step 8
6	1. Turn the Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference circuit open or shorted to ground?	—	Go to Step 12	Go to Step 7
7	Check the 5 volt reference circuit for a poor connection at the Power Inverter Module 32-way connector and replace terminal if necessary. Did the terminal require replacement?	—	Go to Step 12	Go to Step 11

DTC 020 Accelerator Pedal Position (APP) Sensor 3 Circuit Low (continued)

Step	Action	Value(s)	Yes	No
8	1. Turn the Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector, and check the APP3 signal circuit for an open, short to ground. 3. If the APP3 sensor signal circuit is open or shorted to ground, repair it as necessary. Was the APP3 signal circuit open or shorted to ground?	—	Go to Step 12	Go to Step 9
9	Check the APP3 sensor signal circuit for a poor connection at the Power Inverter Module 32-way connector and replace terminal if necessary. Did the terminal require replacement?	—	Go to Step 12	Go to Step 11
10	Replace the APP module. Refer to *APP removal and replacement procedure.* Is the action complete?	—	Go to Step 12	—
11	Replace the faulty Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 12	—
12	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 021 Accelerator Pedal Position (APP) Sensor 3 Circuit High


APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
Power Inverter Module
12
28
15
13
29
16
14
30
31
17
1
C1
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/ WHT 451
BLK/ WHT 451
Ground Distribution Cell 14
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Lo
+5
Lo
+5
Accelerator Pedal Position Sensor

264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 3.5 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 1.5 volts at WOT. Sensor 3 varies from 3.9 volts at closed position to about 2.2 volts at wide open throttle.

Conditions for Setting the DTC

- Voltage is greater than 4.6 volts on APP 3 sensor.
- Conditions met for 16 milliseconds.

Action Taken When the DTC Sets

- The input from APP3 sensor is ignored.
- A current and history DTC will set but it will not turn ON the SERVICE SOON lamp.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

A scan tool reads APP 3 position in volts. Should read about 4.0 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward Wide Open Throttle (WOT).Also, 90% pedal travel is acceptable for correct APP Operation. Scan APP 3 sensor while depressing accelerator pedal with ignition ON. And selector in Park the display should vary from about 4.0 volts when throttle was closed to about 2.0 volts when throttle is held at Wide Open Throttle (WOT) position.

- All three sensors have five volt sources which are independent. Sensors 2 and 3 are inverted by the Drive Motor Control Module of actual reading. 0 - 5 volts.
- The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.
- If the problem is intermittent wiggle the wiring harness while viewing the scan tool and see if the value changes or the DTC sets.
- Check the tightness of the female terminal with a spare male terminal.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Test Description

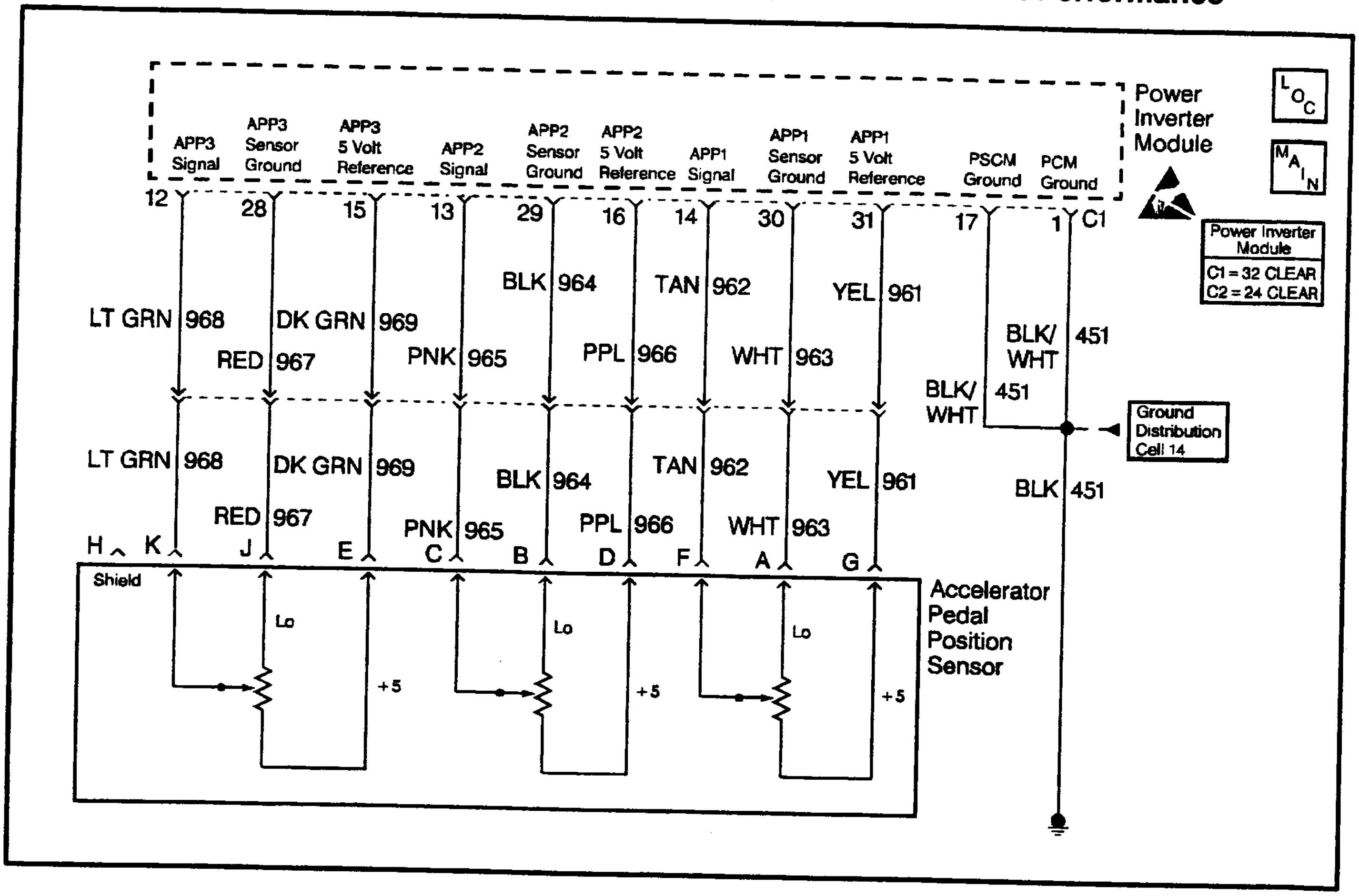
Number(s) below refer to the Step number(s) on Diagnostic Table.

2. This Step will determine if DTC 021 is the result of a hard failure or an intermittent condition.
4. This Step checks the Drive Motor Control Module and wiring.

DTC 021 Accelerator Pedal Position (APP) 3 Circuit High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition ON. 2. With the accelerator pedal released, observe the APP3 display on the scan tool. Is APP3 above the specified value?	4.6V	Go to Step 4	Go to Step 3
3	DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are additional DTC(s) stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Observe the APP3 display on the scan tool. Is APP3 less than the specified value?	.25V	Go to Step 5	Go to Step 6
5	Probe APP3 sensor ground circuit at the APP sensor harness connector with a test light connected to B+. Is the test light ON?	—	Go to Step 7	Go to Step 8
6	1. Check for a short to voltage on the APP3 sensor signal circuit. 2. If the APP3 sensor signal circuit is shorted, repair it as necessary. Was the APP3 sensor signal circuit shorted?	—	Go to Step 11	Go to Step 10
7	Check for poor electrical connections at the APP sensor and replace terminals if necessary Did any terminals require replacement?	—	Go to Step 11	Go to Step 9
8	1. Check for an open sensor ground circuit. 2. If a problem is found, repair it as necessary. Was APP3 sensor ground circuit open?	—	Go to Step 11	Go to Step 10
9	Replace the APP module. Refer to *APP removal and replacement procedure.* Is the action complete?	—	Go to Step 11	—
10	Replace the faulty Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 11	—
11	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 022 Accelerator Pedal Position (APP) Sensor 3 Circuit Performance


APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
12
28
15
13
29
16
14
30
31
17
1
C1
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
BLK/WHT 451
Ground Distribution Cell 14
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Lo
+5
Lo
+5
Accelerator Pedal Position Sensor

264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 3.5 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 1.5 volts at WOT. Sensor 3 varies from 3.9 volts at closed position to about 2.2 volts at wide open throttle.

Conditions for Setting the DTC

- APP3 sensor input voltage changes more than 2.5 volts
- Conditions met for 16 milliseconds.

Action Taken When the DTC Sets

- The input from APP 3 sensor is ignored.
- A current and history DTC will set but it will not turn ON a SERVICE SOON lamp.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion.

Conditions for Clearing the MIL/DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

A scan tool reads APP 3 position in volts. Should read about 4.0 volts with throttle closed and ignition ON or at idle. Voltage should decrease at a steady rate as throttle is moved toward Wide Open Throttle (WOT). Also, 90% pedal travel is acceptable for correct APP operation. Scan APP 3 sensor while depressing accelerator pedal with engine stopped and ignition ON. Display should vary from about 4.0 volts when throttle was closed to about 2.0 volts when throttle is held at Wide Open Throttle (WOT) position.

- All three sensors have five volt sources which are independent. Sensors 2 and 3 are inverted by the Drive Motor Control Module of actual reading. 0 - 5 volts.
- The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.
- If the problem is intermittent wiggle the wiring harness while viewing the scan tool and see if the value changes or the DTC sets.
- Check the tightness of the female terminal with a spare male terminal.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Test Description

Number(s) below refer to the Step number(s) on the Diagnostic Table.

2. This step checks for a good reference voltage.
5. This step checks the APP sensor ground circuits.

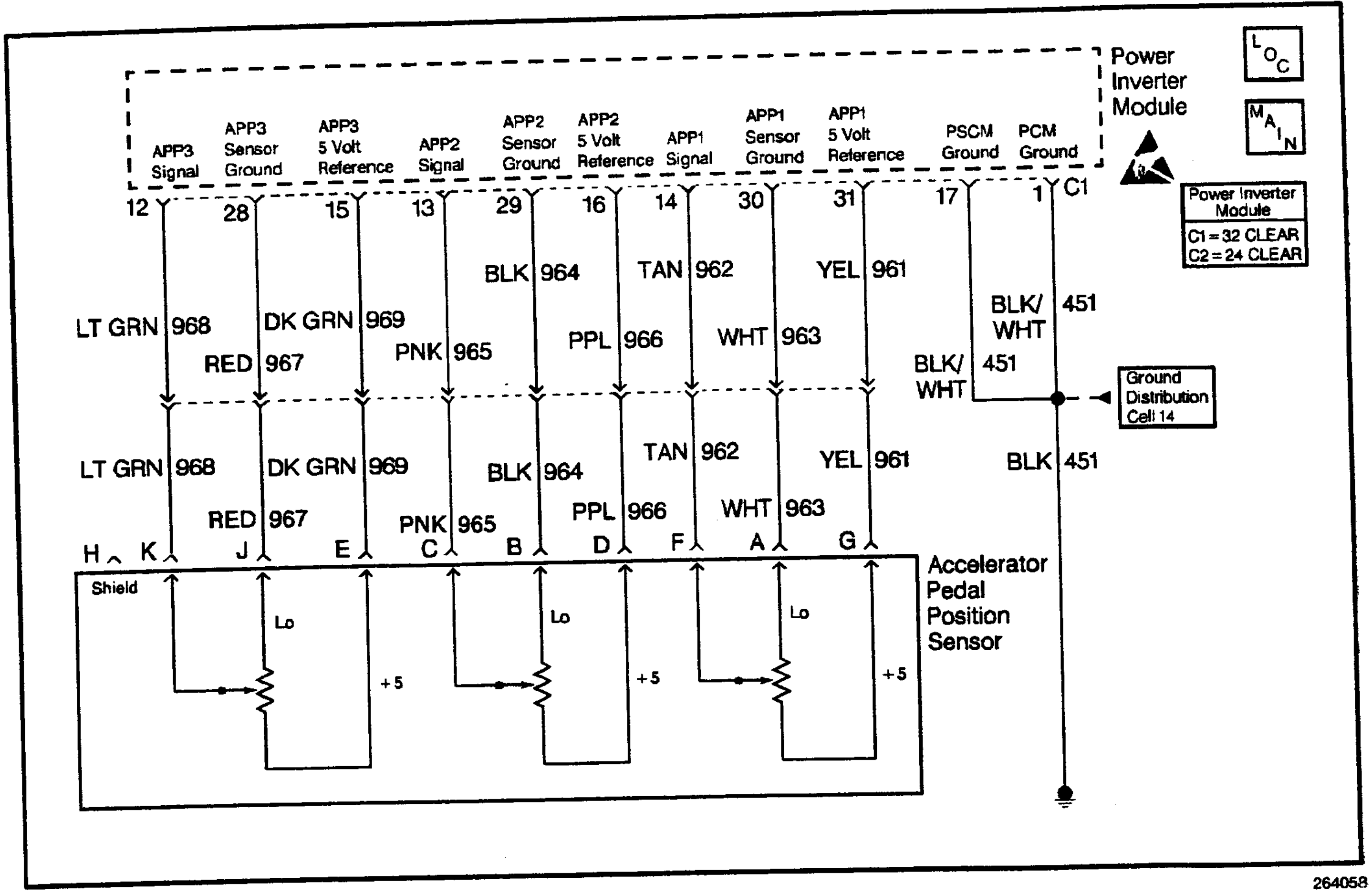
DTC 022 Accelerator Pedal Position (APP) Sensor 3 Circuit Performance

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Ignition ON. 2. With the accelerator pedal released, observe APP1, APP2, and APP3 voltages on the scan tool. Are APP voltages at specified values?	.45-.95V 4.0-4.5V 3.6-4.1V	Go to Step 3	Go to Step 4
3	DTC is intermittent. If no additional DTCs are stored, refer to Diagnostic Aids. If additional DTCs were stored refer to the applicable DTC table(s) first. Are additional DTC(s) stored?	—	Go to the Applicable DTC Table	Go to Diagnostic Aids
4	1. Disconnect the APP sensor electrical connector. 2. Ignition ON. 3. With J 39200 DMM connected to ground, probe APP sensor 5 volt reference circuits at APP harness terminals G, D and E. Is voltage at the specified value on all circuits?	4.75V	Go to Step 5	Go to Step 6
5	1. Ignition ON. 2. With a test light connected to B+, probe APP sensor ground circuits at the APP sensor harness terminals A, B and J. Is Test light ON (all circuits)?	—	Go to Step 9	Go to Step 8
6	1. Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector and check the 5 volt reference circuit for an open or short to ground. 3. If the 5 volt reference circuit is open or shorted to ground, repair it as necessary. Was the 5 volt reference circuit open or shorted to ground?	—	Go to Step 11	Go to Step 7
7	Check the 5 volt reference circuit for a poor connection at the Power Inverter Module 32-way connector and replace terminal if necessary. Did the terminal require replacement?	—	Go to Step 11	Go to Step 10

DTC 022 Accelerator Pedal Position (APP) Sensor 3 Circuit Performance (continued)

Step	Action	Value(s)	Yes	No
8	1. Ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector and check for an open sensor ground circuit. 3. If problem is found, repair as necessary. Was APP sensor ground circuit open?	—	Go to Step 11	Go to Step 10.
9	Replace the APP module. Refer to *APP removal and replacement procedure.* Is the action complete?	—	Go to Step 11	—
10	Replace the faulty Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 11	—
11	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 023 Accelerator Pedal Position Sensor Circuits 1 and 2


Power Inverter Module
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
12
28
15
13
29
16
14
30
31
17
1
C1
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
LOC
MAIN
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
Ground Distribution Cell 14
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Accelerator Pedal Position Sensor
264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 4.2 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 0.8 volts at WOT. Sensor 3 varies from 4.0 volts at closed position to about 1.9 volts at WOT. The Drive Motor Control Module re-scales each of the channels and then compares each channel to the other two in order to detect in-range sensor faults.

Conditions for Setting the DTC

- Sensor 1 and sensor 2 differ more than 6.25% for 1 second from each other.

Action Taken When the DTC Sets

- A current and history DTC will set but it will not turn ON a SERVICE SOON lamp.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion. The Drive Motor Control Module re-scales each of the channels and then compares each channel to the other two in order to detect in-range sensor failures.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

Check for the following conditions:

- The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.
- All three sensors have five volt sources which are independent. Pedal position sensors 2 and 3 are inverted of actual reading 0 = 5 volts.
- Check the tightness of the female terminal grip with a spare male terminal.
- If the problem is intermittent, wiggle the wire harness while viewing the scan tool and see if the value changes or the DTC sets.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks 5 volt reference on APP 1 and APP 2.
4. This step checks APP sensor 1 resistance at the Power Inverter Module.
5. This step checks APP sensor 2 resistance at the Power Inverter Module.
6. This step checks APP sensor 1 resistance at the APP sensor.
7. This step checks APP sensor 2 resistance at the APP sensor.

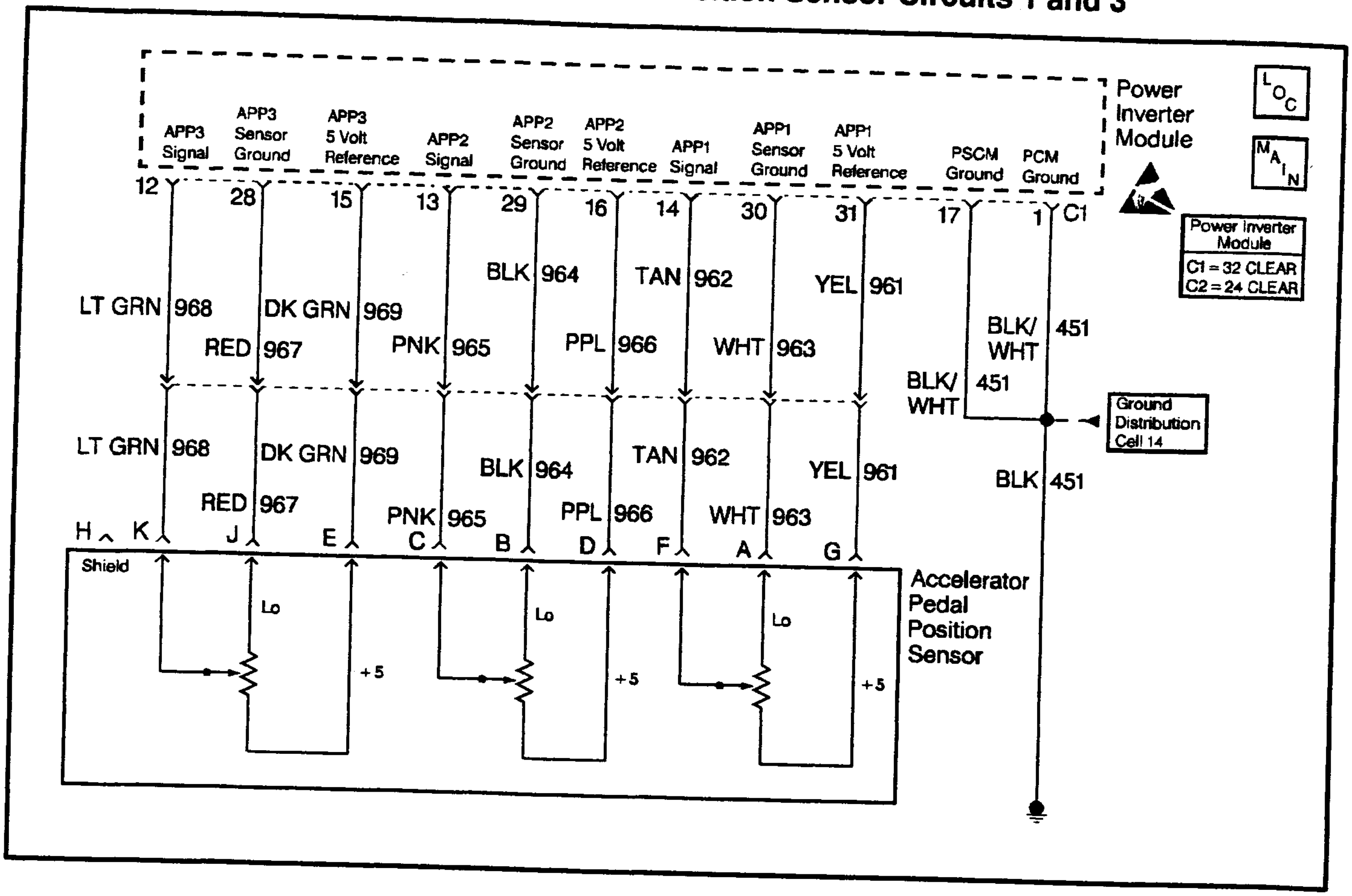
DTC 023 Accelerator Pedal Position Sensor Circuits 1 and 2

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition ON. 2. Using a scan tool capture failure records information. 3. Clear DTC(s) 4. Depress and release the accelerator pedal. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	Back probe pedal position sensor pins G and D to ground. Do bolt circuits read at the specified value?	5 Volts ± .5V	Go to Step 4	Go to Step 8
4	1. Disconnect the 32 way connector at the Power Inverter module. 2. Using a DMM, measure the resistance between pins 14 and 30 on the Power Inverter Module 32-way while depressing the accelerator pedal to the floor. 3. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 5	Go to Step 6

DTC 023 Accelerator Pedal Position Sensor Circuits 1 and 2 (continued)

Step	Action	Value(s)	Yes	No
5	1. Using a DMM, measure the resistance between pins 13 and 29 on the Power Inverter module 32 way connector while depressing the accelerator pedal to the floor. 2. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 9	Go to Step 7
6	1. Disconnect the pedal position sensor connector. 2. Using a DMM, measure the resistance between pins A and F of the pedal position sensor while depressing the accelerator pedal to the floor. 3. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 11	Go to Step 12
7	1. Using a DMM, measure the resistance between pins C and B of the pedal position sensor while depressing the accelerator pedal to the floor. 2. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 11	Go to Step 12
8	Repair the 5 volt reference circuit. Is the action complete?	—	Go to Step 13	—
9	Check for a poor connection at the PIM 32-way connector. Was a poor connection found?	—	Go to Step 11	Go to Step 10
10	Replace the Power Inverter module. Refer to *Power Inverter Module replacement and programming procedures.* Is the action complete?	—	Go to Step 13	—
11	Repair wiring between the APP sensor and the Power Inverter Module. Is the action complete?	—	Go to Step 13	—
12	Replace the APP sensor. Refer to *Pedal position sensor removal and replacement.* Is the action complete?	—	Go to Step 13	—
13	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 024 Accelerator Pedal Position Sensor Circuits 1 and 3


Power Inverter Module
LOC
MAIN
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
12
28
15
13
29
16
14
30
31
17
1
C1
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/ WHT 451
BLK/ WHT 451
Ground Distribution Cell 14
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Lo
+5
Lo
+5
Accelerator Pedal Position Sensor

264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 4.2 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 0.8 volts at WOT. Sensor 3 varies from 4.0 volts at closed position to about 1.9 volts at WOT. The Drive Motor Control Module re-scales each of the channels and then compares each channel to the other two in order to detect in-range sensor failures.

Conditions for Setting the DTC

- Sensor 1 and sensor 3 differ more than 12.5% for 1 second from each other.

Action Taken When the DTC Sets

- A current and history DTC will set but it will not turn ON a SERVICE SOON lamp.
- The fault will be latched for the remainder of the ignition cycle.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

Check for the following conditions:

- The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.
- All three sensors have five volt sources which are independent. Pedal position sensors 2 and 3 are inverted of actual reading 0 = 5 volts.
- Check the tightness of the female terminal grip with a spare male terminal.
- If the problem is intermittent, wiggle the wire harness while viewing the scan tool and see if the value changes or the DTC sets.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks 5 volt reference.
4. This step checks APP sensor resistance at the Power Inverter Module.
6. This step checks APP sensor resistance at the APP sensor.

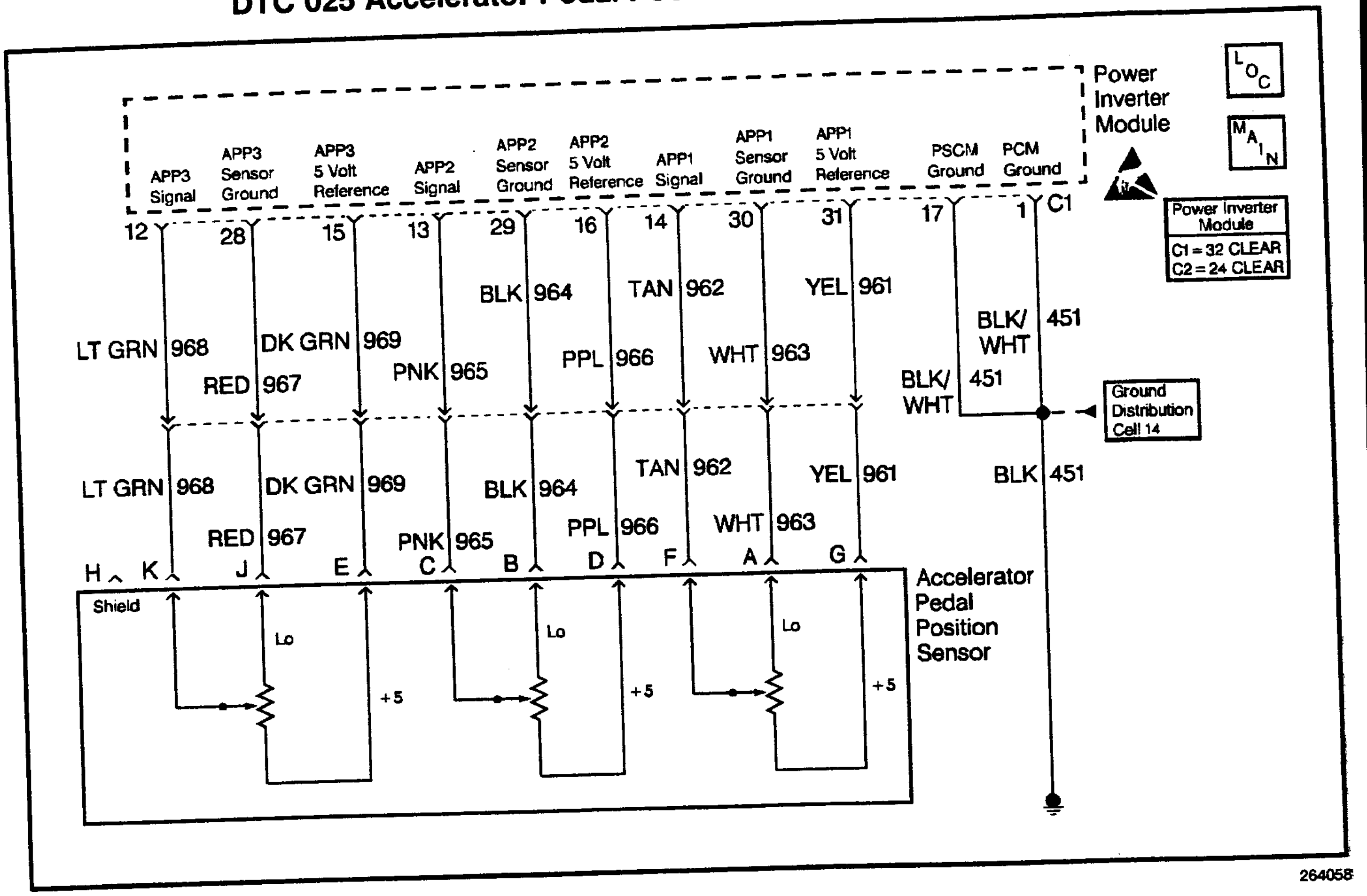
DTC 024 Accelerator Pedal Position Sensor Circuits 1 and 3

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition ON. 2. Using a scan tool capture failure records information. 3. Clear DTC(s) 4. Depress and release the accelerator pedal. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	Back probe pedal position sensor pins G and D to ground. Do bolt circuits read at the specified value?	5 Volts ± .5V	Go to Step 4	Go to Step 8
4	1. Disconnect the 32 way connector at the Power Inverter module. 2. Using a DMM, measure the resistance between pins 14 and 30 on the Power Inverter Module 32-way while depressing the accelerator pedal to the floor. 3. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 5	Go to Step 6
5	1. Using a DMM, measure the resistance between pins 12 and 28 on the Power Inverter module 32 way connector while depressing the accelerator pedal to the floor. 2. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 9	Go to Step 7

DTC 024 Accelerator Pedal Position Sensor Circuits 1 and 3 (continued)

Step	Action	Value(s)	Yes	No
6	1. Disconnect the pedal position sensor connector. 2. Using a DMM, measure the resistance between pins A and F of the pedal position sensor while depressing the accelerator pedal to the floor. 3. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 11	Go to Step 12
7	1. Using a DMM, measure the resistance between pins J and K of the pedal position sensor while depressing the accelerator pedal to the floor. 2. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 11	Go to Step 12
8	Repair the 5 volt reference circuit. Is the action complete?	—	Go to Step 13	—
9	Check for a poor connection at the PIM 32-way connector. Was a poor connection found?	—	Go to Step 11	Go to Step 10
10	Replace the Power Inverter module. Refer to *Power Inverter Module replacement and programming procedures.* Is the action complete?	—	Go to Step 13	—
11	Repair wiring between the APP sensor and the Power Inverter Module. Is the action complete?	—	Go to Step 13	—
12	Replace the APP sensor. Refer to *Pedal position sensor removal and replacement.* Is the action complete?	—	Go to Step 13	—
13	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 025 Accelerator Pedal Position Sensor Circuits 2 and 3


Power Inverter Module
L O C
M A I N
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
C1
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
12
28
15
13
29
16
14
30
31
17
1
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
BLK/WHT 451
Ground Distribution Cell 14
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Lo
+5
Lo
+5
Accelerator Pedal Position Sensor
264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 4.2 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 0.8 volts at WOT. Sensor 3 varies from 4.0 volts at closed position to about 1.9 volts at WOT. The Drive Motor Control Module re-scales each of the channels and then compares each channel to the other two in order to detect in-range sensor failures.

Conditions for Setting the DTC

- APP sensor 2 and sensor 3 differ more than 15.6% for 1 second from each other.

Action Taken When the DTC Sets

- A current and history DTC will set but it will not turn ON a SERVICE SOON lamp.
- The fault will be latched for the remainder of the ignition cycle.
- The throttle will operate normally as long as there is only one sensor malfunctioning. If two different APP sensors have a malfunction, the SERVICE SOON lamp will light and the Drive Motor Control Module will limit power. If three APP sensors have a malfunction present, the SERVICE NOW lamp will light and the Drive Motor Control Module will disable propulsion.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle without the fault present.

Diagnostic Aids

The table below contains typical resistance values for the APP sensor. These values are approximate ± 20%.

APP RESISTANCE TABLE

Location/Terminal		Throttle Position	
PIM	APP	Closed	Open
14 & 30	F & A	2.2K ohms	4.4K ohms
13 & 29	C & B	3.3K ohms	1.1K ohms
12 & 28	J & K	5.9K ohms	3.6K ohms

Check for the following conditions:

- The slope of each sensor is different which enables identification of which potentiometer has failed. Pedal position sensors 2 and 3 are pulled high while pedal position sensor 1 is pulled low.
- All three sensors have five volt sources which are independent. Pedal position sensors 2 and 3 are inverted of actual reading 0 = 5 volts.
- Check the tightness of the female terminal grip with a spare male terminal.
- If the problem is intermittent, wiggle the wire harness while viewing the scan tool and see if the value changes or the DTC sets.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks 5 volt reference.
4. This step checks APP sensor resistance at the Power Inverter Module.
6. This step checks APP sensor resistance at the APP sensor.

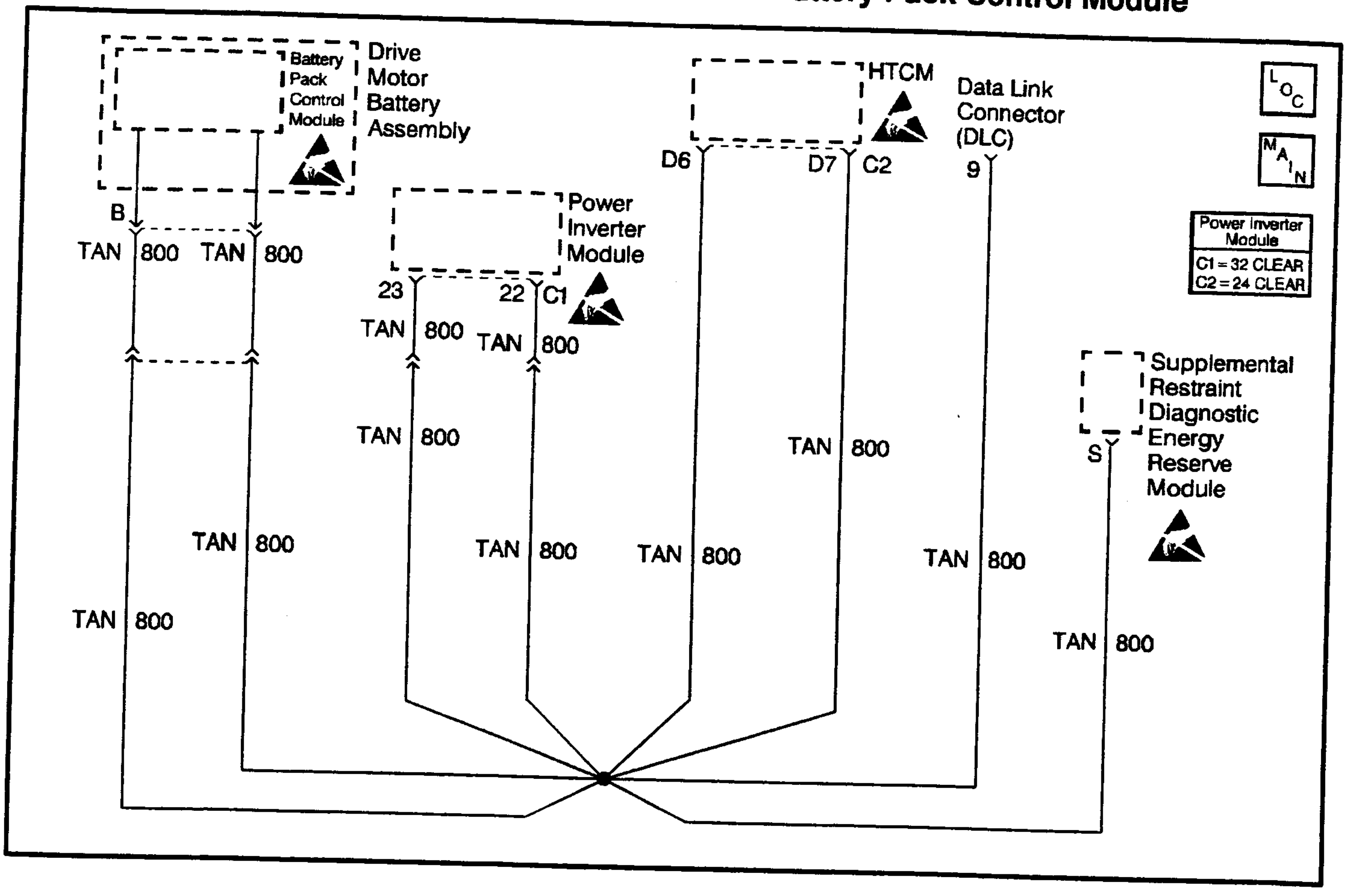
DTC 025 Accelerator Pedal Position Sensor Circuits 2 and 3

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition ON. 2. Using a scan tool capture failure records information. 3. Clear DTC(s) 4. Depress and release the accelerator pedal. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	Back probe pedal position sensor pins G and D to ground. Do bolt circuits read at the specified value?	5 Volts ± .5V	Go to Step 4	Go to Step 8
4	1. Disconnect the 32 way connector at the Power Inverter module. 2. Using a DMM, measure the resistance between pins 13 and 29 on the Power Inverter Module 32-way while depressing the accelerator pedal to the floor. 3. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 5	Go to Step 6
5	1. Using a DMM, measure the resistance between pins 12 and 28 on the Power Inverter module 32 way connector while depressing the accelerator pedal to the floor. 2. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 9	Go to Step 7

DTC 025 Accelerator Pedal Position Sensor Circuits 2 and 3 (continued)

Step	Action	Value(s)	Yes	No
6	1. Disconnect the pedal position sensor connector. 2. Using a DMM, measure the resistance between pins C and B of the pedal position sensor while depressing the accelerator pedal to the floor. 3. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 11	Go to Step 12
7	1. Using a DMM, measure the resistance between pins J and K of the pedal position sensor while depressing the accelerator pedal to the floor. 2. Compare the reading to the APP resistance table on the facing page. The resistance should be within the limits on the table. Is the measured resistance within the specified value?	—	Go to Step 11	Go to Step 12
8	Repair the 5 volt reference circuit. Is the action complete?	—	Go to Step 13	—
9	Check for a poor connection at the PIM 32-way connector. Was a poor connection found?	—	Go to Step 11	Go to Step 10
10	Replace the Power Inverter module. Refer to *Power Inverter Module replacement and programming procedures.* Is the action complete?	—	Go to Step 13	—
11	Repair wiring between the APP sensor and the Power Inverter Module. Is the action complete?	—	Go to Step 13	—
12	Replace the APP sensor. Refer to *Pedal position sensor removal and replacement.* Is the action complete?	—	Go to Step 13	—
13	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 026 Loss of Communications With Battery Pack Control Module


Battery Pack Control Module
Drive Motor Battery Assembly
Power Inverter Module
HTCM
Data Link Connector (DLC)
Supplemental Restraint Diagnostic Energy Reserve Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
B
23
22
C1
D6
D7
C2
9
S
TAN
800
264084

Circuit Description

The serial data line is used to transmit data between the Drive Motor Control Module and the Battery Pack Control Module during normal operation. If the Drive Motor Control Module does not receive valid data from the Battery Pack Control Module it will operate on substitute default data.

Conditions for Setting the DTC

- Key ON.
- The Drive Motor Control Module does not receive data from the Battery Pack Control Module for more than 31 seconds.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE SOON light.
- DTC will be stored in failure records buffer.
- Drive Motor Control Module operates with default values.

Conditions for Clearing the DTC

- The DTC will clear after 10 seconds of a no fault condition and the Drive Motor Control Module will return to normal operation.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Refer to the No Serial Data DTC facing page.
- Inspect all UART connectors for loose or damaged terminals.
- The OBD system check may be of further assistance in diagnosis

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

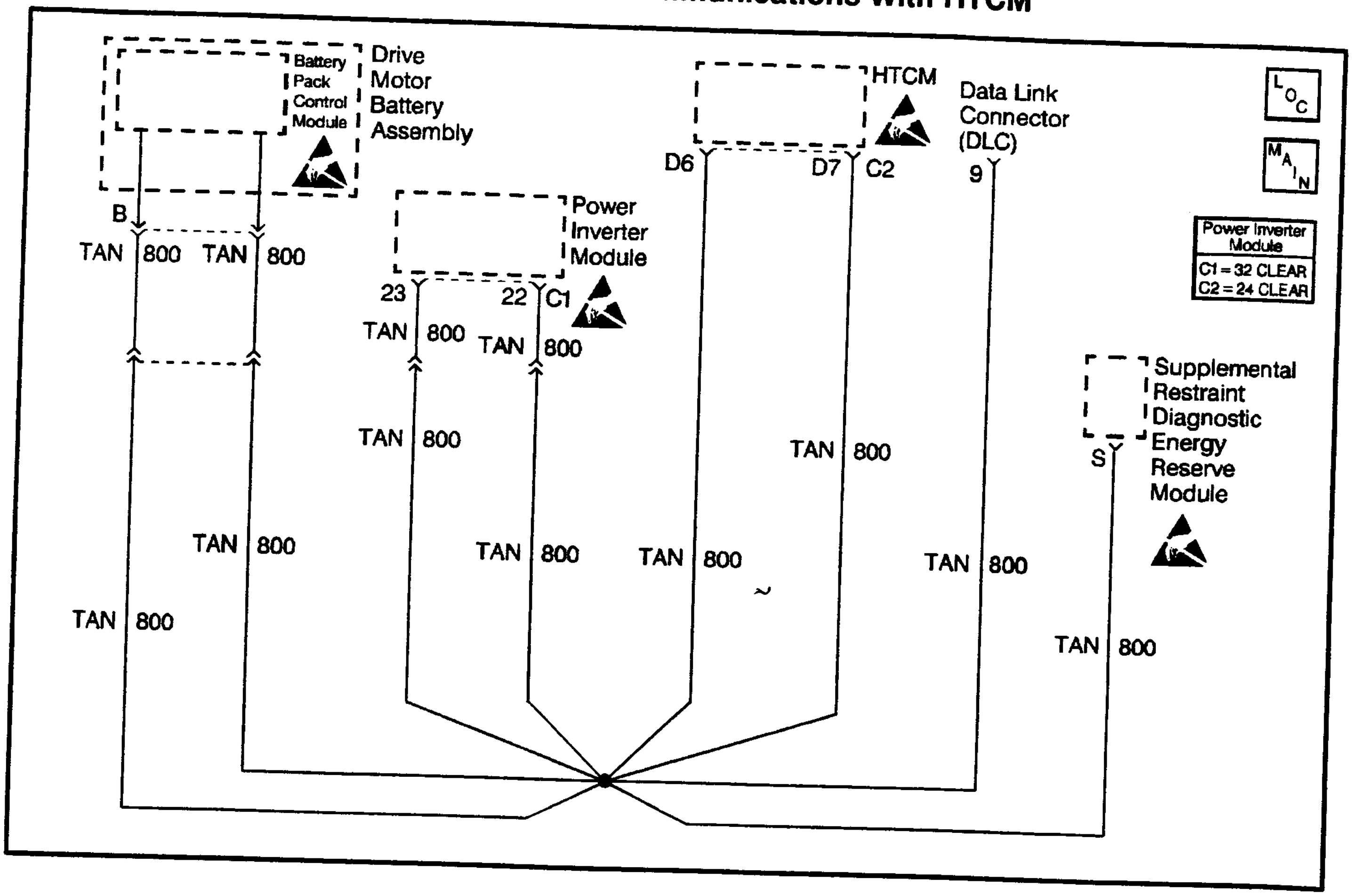
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for a current DTC.

DTC 026 Loss of Communications With Battery Pack Control Module

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is Drive Motor Control Module DTC 026 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Are any other UART DTC(s) set?	—	Go to other DTC)s) first	Go to Step 4
4	Repair the Battery Pack. Refer to *Battery Pack internal service manual.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 029 Loss of Communications With HTCM


Battery Pack Control Module
Drive Motor Battery Assembly
B
TAN 800
TAN 800
Power Inverter Module
23
22
C1
HTCM
D6
D7
C2
Data Link Connector (DLC)
9
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Supplemental Restraint Diagnostic Energy Reserve Module
S
TAN 800

264084

Circuit Description

The serial data line is used to transmit data between the Drive Motor Control Module and the HTCM during normal operation. If the Drive Motor Control Module does not receive valid data from the HTCM it will operate on substitute default data.

Conditions for Setting the DTC

- The Drive Motor Control Module does not receive data from the HTCM for more than 32 seconds.

Action Taken When the DTC Sets

- The Drive Motor Control Module will turn on the SERVICE SOON light.
- DTC will be stored in failure records buffer.
- Drive Motor Control Module operates with default values.

Conditions for Clearing the DTC

- The DTC will clear after 10 seconds of no fault condition and the Drive Motor Control Module will return to normal operation.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Refer to the No Serial Data facing page.
- Inspect all UART connectors for loose or damaged terminals
- The OBD system check may be of further assistance in diagnosis

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks for communication with the HTCM.

DTC 029 Loss of Communications With HTCM

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is Drive Motor Control Module DTC 029 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Are any other UART DTC(s) set?	—	Go to other DTC)s) first	Go to Step 4
4	Replace the HTCM. Refer to *HTCM removal and replacement procedure.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 030 Drive Motor Control Module Circuit

Circuit Description

The Drive Motor Control Module performs an on-board, continuous RAM test during normal operation.

Conditions for Setting the DTC

- A RAM fault is detected by the Drive Motor Control Module.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.
- The Drive Motor Control Module will flash the SERVICE SOON light once.
- The Drive Motor Control Module will Reset.

In the event of a hard RAM fault:

- The Drive Motor Control Module will continuously Reset
- The Drive Motor Control Module will continuously flash the SERVICE SOON light
- Propulsion is disabled

Conditions for Clearing the DTC

- If the Reset is successful the Drive Motor Control Module will resume normal operation.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- Random RAM resets are possible. If a DTC 030 set intermittently replace the Power Inverter Module.
- A RAM fault may corrupt Drive Motor Control Module data displayed on the scan tool.

Reviewing the Failure Record's since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This DTC is caused by an internal Power Inverter Module fault.

DTC 030 Drive Motor Control Module Circuit

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Replace the Power Inverter Module Refer to *Power Inverter Module removal and reprogramming.* Is the action complete?	—	Go to Step 3	—
3	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 031 Drive Motor Control Module Circuit

Circuit Description

The Drive Motor Control Module performs an on-board, continuous ROM test during normal operation.

Conditions for Setting the DTC

- A ROM fault is detected by the Drive Motor Control Module.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.
- The Drive Motor Control Module will flash the SERVICE SOON light once.
- The Drive Motor Control Module will Reset.

In the event of a hard ROM fault:

- The Drive Motor Control Module will continuously Reset.
- The Drive Motor Control Module will continuously flash the SERVICE SOON light.
- Propulsion is disabled.

Conditions for Clearing the DTC

- If the Reset is successful the Drive Motor Control Module will resume normal operation
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Random ROM resets are possible. If a DTC 031 set intermittently replace the Power Inverter Module.
- A ROM fault may corrupt Drive Motor Control Module data displayed on the scan tool.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

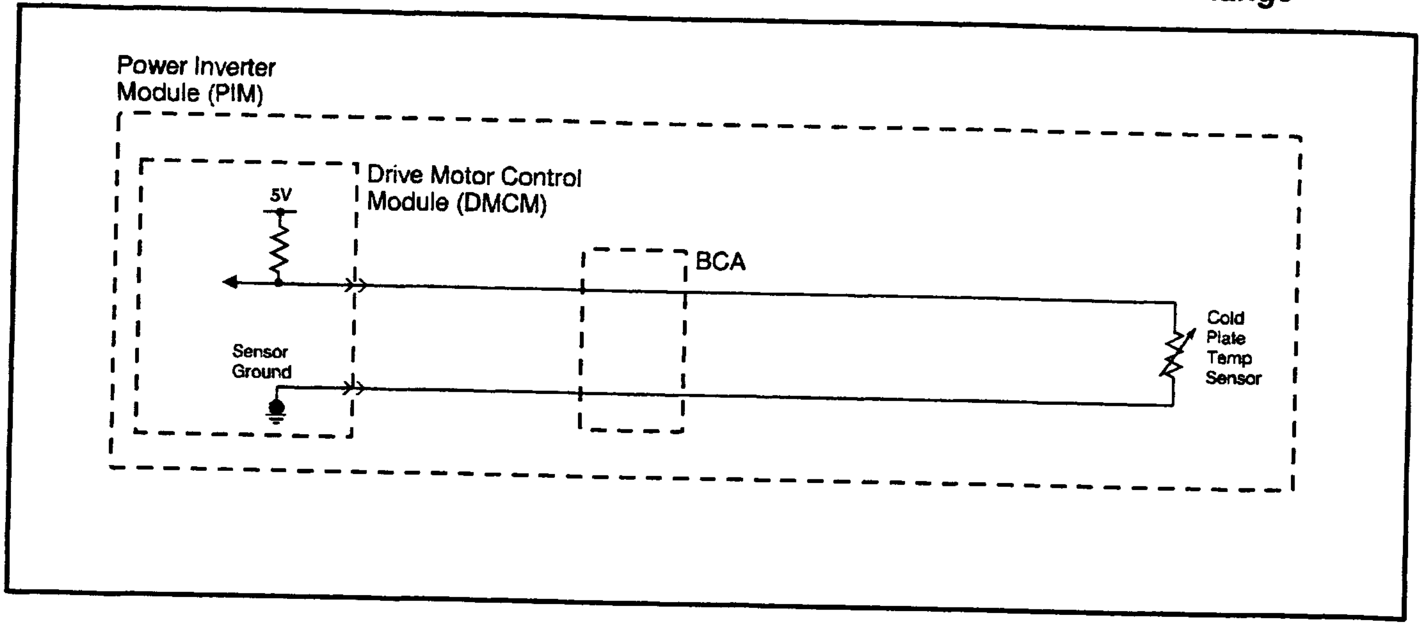
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This DTC is caused by an internal Power Inverter Module fault.

DTC 031 Drive Motor Control Module Circuit

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation.* Is the action complete?	—	Go to Step 3	—
3	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 034 Power Inverter Module Temperature Sensor Circuit Out Of Range



Circuit Description

The Power Inverter module temperature sensor is a thermistor which senses the Power Inverter Module cold-plate temperature. The Drive Motor Control Module applies a 5 volt reference to the thermistor and monitors voltage on the return line. The voltage is converted to a temperature value by the Drive Motor Control Module. The temperature sensor is internal to the Power Inverter Module and is not serviceable.

Conditions for Setting the DTC

- The Drive Motor Control Module senses cold plate temperature greater than 74°C (166°F).

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.
- The TEMP light is illuminated.

Conditions for Clearing the DTC

- The DTC will clear if the value drops to 68°C (154°F).
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for a current or intermittent problem.
3. If the cooling system is faulty refer to *Propulsion System Cooling* .

DTC 034 Power Inverter Module Temperature Sensor Circuit Out Of Range

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Clear the DTC using the scan tool. 2. Drive the vehicle. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	Check cooling system operation. Refer To *Propulsion System Cooling* . Is the cooling system in normal operating range?	—	Go to Step 5	Go to Step 4
4	Repair cooling system. Is the action complete?	—	Go to Step 6	—
5	Replace the Power Inverter Module. Refer To *Power Inverter Module removal and reprogramming.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 036 Performance Limited

Circuit Description

The Power Inverter Module Temperature Sensor is a thermistor which senses the Inverter Module cold-plate temperature. The Drive Motor Control Module applies a 5 volt reference to the thermistor and monitors voltage on the return line. The voltage is converted to a temperature value by the Drive Motor Control Module. The Temperature sensor is internal to the Drive Motor Power Inverter Module and is not serviceable. If either the Drive Motor Temperature Sensor or the Drive Motor Power Inverter Module Temperature Sensor exceed a maximum value performance will be limited and DTC 036 will be set.

Conditions for Setting the DTC

- Drive Motor winding temperature is greater than 170°C (338°F) or Power Inverter Module temperature is greater than 125°C (257°F).

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.
- Drive Motor Control Module illuminates the TEMP light.
- Cruise Control Disabled.
- Performance is reduced.

Conditions for Clearing the DTC

- DTC will be cleared and performance is re-enabled when the temperature drops five degrees below the code setting conditions.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Check for proper operation of the cooling system. Refer to *Propulsion System Cooling.*
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Reviewing the Fail Record's vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

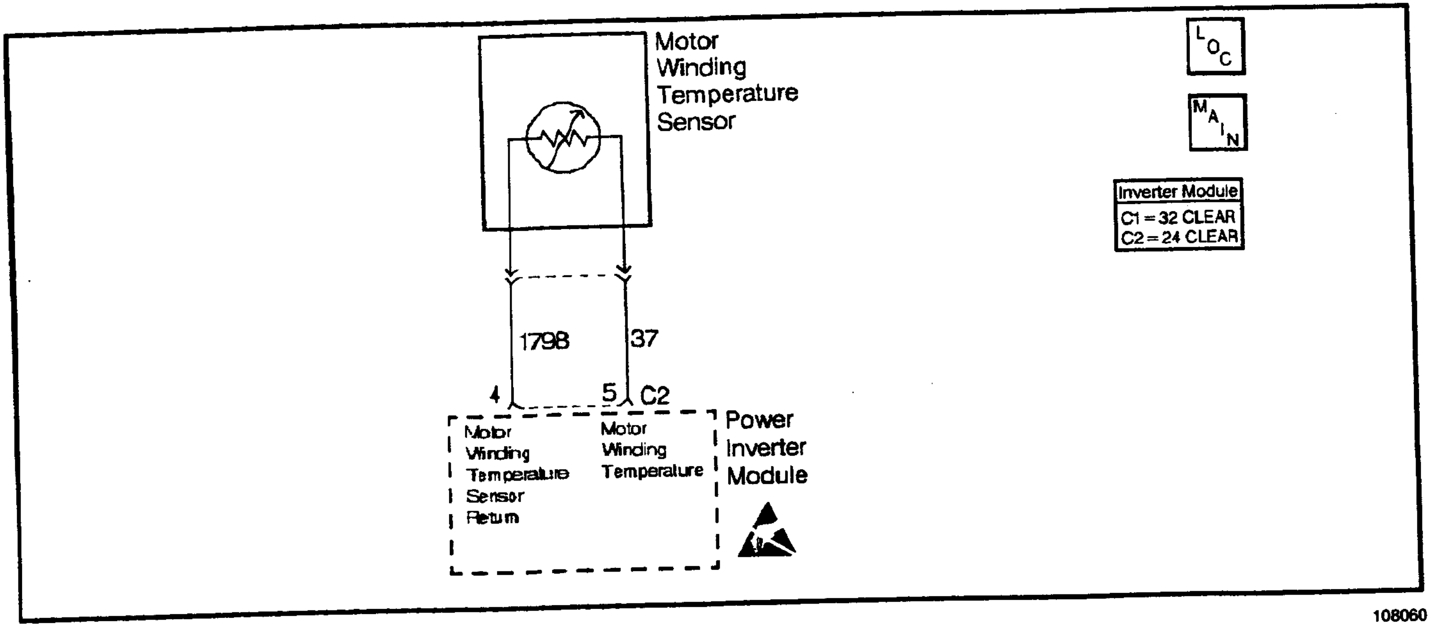
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for other DTC(s) first.

DTC 036 Performance Limited

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any other Drive Motor or Power Inverter Module temperature DTCs set?	—	Go to other DTCs first	Go to Step 3
3	Replace the Power Inverter Module. Refer to *Power Inverter Module replacement and reprogramming.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 037 Drive Motor Winding Temperature Sensor Out of Range


Motor Winding Temperature Sensor
1798
37
4
5
C2
Motor Winding Temperature Sensor Return
Motor Winding Temperature
Power Inverter Module
LOC
MAIN
Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR

108060

Circuit Description

The Motor winding temperature sensor is a thermistor which senses the motor winding temperature. The Drive Motor Control Module applies a 5 volt reference to the thermistor and monitors the voltage on the return line. This voltage is converted to a temperature value by the Drive Motor Control Module. The temperature sensor is internal to the Drive Motor and is not serviceable.

Conditions for Setting the DTC

- Drive Motor Control Module sees motor winding temperature greater than 165°C (329°F).

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.
- Drive Motor Control Module illuminates the TEMP light.

Conditions for Clearing the DTC

- TEMP light will extinguish if temperature drops below 160°C (320°F).
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- This DTC may be set under severe driving conditions.
- Check for a restricted coolant system.
- Check for coolant pump performance.
- It may be necessary to drive the vehicle to duplicate the fault conditions.
- After an overnight soak the temperature of the Power Inverter Module temperature sensor and the drive motor winding temperature sensor should be within 4°C of each other.
- Use the table below to diagnosis a skewed sensor.

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	314K
-30	-22	168K
-20	-4	936K
0	32	320K
10	50	197K
20	68	197K
30	86	80K
40	104	54K
50	122	36K
60	140	25K
70	158	18K
80	176	12.7K
90	194	9284
100	212	6861
110	230	5143
120	248	3907
130	266	3004
140	284	2337
150	302	1837
160	320	1456
170	338	1166
180	356	943
190	374	769
200	392	633

Reviewing the Failure Records vehicle mileage since th diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. Thi may assist in diagnosing the condition.

Test Description

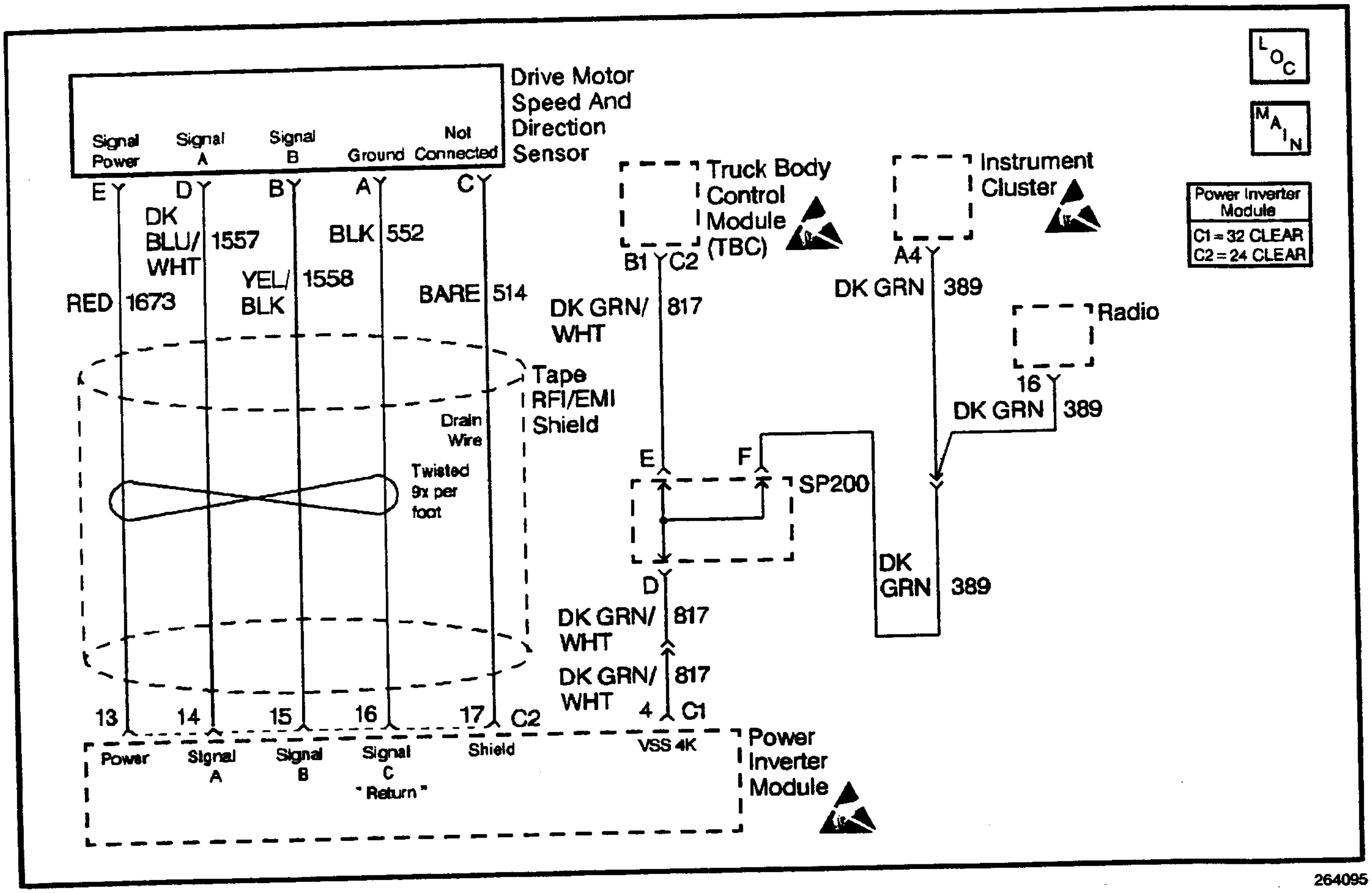
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for DMCM DTC(s) 003 and 004 first.
5. A faulty cooling system may set this DTC.
6. This checks the resistance of the sensor.
7. This checks for an open or short in the wires between the Power Inverter Module and the drive motor.

DTC 037 - Drive Motor Winding Temperature Sensor Out of Range

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are Drive Motor Control Module DTCs 003 or 004 also set?	—	Go to other DTC(s) first	Go to Step 3
3	Are any other temperature related DTC(s) set?	—	Go to other DTC(s) first	Go to Step 4
4	Is Drive Motor Control Module DTC 037 current?	—	Go to Step 5	Go to Diagnostic Aids
5	Check cooling system for proper operation. Refer to *Propulsion System Cooling.* Was a problem found in the cooling system?	—	Go to Step 11	Go to Step 6
6	1. Remove the 24-way connector at the Power Inverter Module. 2. Measure the resistance between pins 5 and 4 of the harness using a DMM. 3. Using the resistance table in diagnostic aids. compare the resistance value from the DMM to the scan tool temperature value. Does the resistance value relate to the scan tool temperature value?	± 5°C	Go to Step 9	Go to Step 7
7	1. Remove the drive motor winding temperature sensor connector. 2. Check for high resistance between the Power Inverter Module and the drive motor temperature sensor harness connector. Is the resistance at or less than the specified value?	.5 ohms	Go to Step 10	Go to Step 8
8	Repair the high resistance problem in the temperature sensor wiring harness. Is the action complete?	—	Go to Step 11	—
9	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the repair complete?	—	Go to Step 11	—
10	Replace the drive motor assembly. Refer to *Drive Motor and Front Axles.* Is the repair complete?	—	Go to Step 11	—
11	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 043 Power Inverter Module Speed and Direction Sensor Circuit


Drive Motor Speed And Direction Sensor
Signal Power
Signal A
Signal B
Ground
Not Connected
E
D
B
A
C
RED 1673
DK BLU/WHT 1557
YEL/BLK 1558
BLK 552
BARE 514
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
13
14
15
16
17
C2
Power
Signal A
Signal B
Signal C "Return"
Shield
VSS 4K
4
C1
Power Inverter Module
Truck Body Control Module (TBC)
B1
C2
DK GRN/WHT 817
E
F
SP200
D
Instrument Cluster
A4
DK GRN 389
Radio
16
DK GRN 389
DK GRN 389
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
264095

Circuit Description

The BCA receives two separate square wave signals from the speed sensor at 128 pulses per revolution. They are channel A and B. The Bias Control Assembly contains on-board diagnostic circuitry which can detect several types of faults which are classified as critical or non-critical. There are multiple critical faults defined, but only one non-critical fault defined by the BCA (speed and direction sensor fault). When the Bias Control Assembly detects a critical fault, it asserts the critical fault line to the Drive Motor Control Module. The Bias Control Assembly also contains an on-board fault register which contains additional fault information. This fault register is read serially by the Drive Motor Control Module after a critical or non-critical fault.

Conditions for Setting the DTC

- There are six transitions on one channel before you see any transitions on the other.
- BCA non-critical fault input is high for 30 milliseconds.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE NOW light.
- DTC will be stored in failure records buffer.
- Propulsion is disabled.
- Immediately after receiving a non-critical fault, the Drive Motor Control Module reads the Bias Control Assembly fault register and sets additional DTCs based on the information it receives. (See DTC 076). Once a non-critical fault has been detected, it is latched by the Drive Motor Control Module for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Drive Motor Control Module DTC 076 will always set in conjunction with Drive Motor Control Module DTC 043.
- Check for loose or damaged terminals at the Drive Motor Speed and Direction Sensor and the Power Inverter Module.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks to see if the fault is present.
3. Checks to see if the Drive Motor Control Module switches from forward to reverse.

DTC 043 Power Inverter Module Speed and Direction Sensor Circuit

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Clear the DTC. 2. Attempt to drive the vehicle. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Connect the drive motor speed and direction signal generator J 42241 and send a reverse signal to the Power Inverter Module. 2. Using the scan tool check for reverse vehicle speed. Does the scan tool display vehicle speed at the specified value? Notice: After switching signal generator J 42241 back to OFF from the REVERSE position, DMCM DTCs 043, 076, and 080 will be set. This is a normal result during this test.	30 ± 3 mph	Go to Step 5	Go to Step 4
4	Disconnect the Power Inverter Module 24-way connector and check circuits 1557 and 1558 for open or short to ground. Was the problem found?	—	Go to Step 7	Go to Step 6
5	Check the Drive motor speed and direction sensor harness connector for poor connection. Was a poor connection found?	—	Go to Step 7	Go to Step 8
6	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation* procedure. Is the repair complete?	—	Go to Step 9	—
7	Repair the open or short to ground in the Drive Motor Power Inverter Module Speed and Direction Sensor Circuit. Is the repair complete?	—	Go to Step 9	—
8	Replace the Drive Motor Speed and Direction Sensor. Refer to *Drive Motor Speed and Direction Sensor Removal and Installation* procedure. Is the repair complete?	—	Go to Step 9	—
9	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 044 Power Inverter Module Bias Control System

Circuit Description

The Bias Control Assembly contains on-board diagnostic circuitry can detect several types of faults which are classified as critical or non-critical. There are multiple critical faults defined, but only one non-critical fault defined by the Bias Control Assembly (speed/direction sensor fault). When the Bias Control Assembly detects a critical fault, it asserts the critical fault line to the Drive Motor Control Module. The Bias Control Assembly also contains an on-board fault register which contains additional fault information. This fault register is read serially by the Drive Motor Control Module after a critical or non-critical fault occurs.

Conditions for Setting the DTC

- Bias Control Assembly critical fault input is high for 30 milliseconds.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE NOW light.
- DTC will be stored in failure records buffer.
- Propulsion is disabled.
- Immediately after receiving a fault, the Drive Motor Control Module reads the Bias Control Assembly fault register and sets additional DTCs based on the information it receives. Once a fault has been detected, it is latched by the Drive Motor Control Module for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- This DTC should always set in conjunction with DMCM DTC(s) 081-088 if the Power Inverter Module is working correctly.
- The Power Inverter Module will detect critical faults within 0.5 seconds of occurrence
- Critical faults are defined as those faults affecting vehicle control.

The Power Inverter Module will detect the following critical faults:

- Drive motor phase fault
- High voltage DC over-voltage
- Slip command fault
- Current command fault
- High voltage interlock fault
- Bias Control Assembly bias under-voltage

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Check for other DTC(s) first.

DTC 044 Power Inverter Module Bias Control System

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any other DTCs set?	—	Go to other DTCs first	Go to Step 3
3	Is DTC 044 Current?	—	Go to Step 4	Go to Diagnostic Aids
4	Replace the Power Inverter Module. Refer to *Power Inverter Module removal and reprogramming.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 045 Power Inverter Module Bias Control Voltage Low

Circuit Description

The Bias Control Assembly contains on-board bias power supply which operates off 312 volts. The Drive Motor Control Module receives a discrete input which is high in the event of a bias supply problem. If the Bias Control Assembly sees low voltage or is unable to power-up, the Bias Control Assembly fault input will be high.

Conditions for Setting the DTC

- Bias Control Assembly bias fault input is high for 30 milliseconds.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE NOW light.
- DTC will be stored in the failure records buffer.
- Propulsion is disabled.
- Fault is latched for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Check run 2 power at the Power Inverter Module 32-way for 12 volts.
- Refer to *Intermittent* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for a low pack voltage condition before replacing the Power Inverter Module.
3. Checks for run 2 voltage to the Power Inverter Module.

DTC 045 Power Inverter Module Bias Control Voltage Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are Drive Motor Control Module DTCs 005 or 071 also set?	—	Go to other DTCs first	Go to Step 3
3	Check terminal 26 of the Power Inverter Module 32-way connector during a key-up for the specified value. Was the voltage at the specified value?	12 volts	Go to Step 5	Go to Step 4
4	Repair no run 2 power to the Power Inverter Module. Refer to *8A wiring.* Is the repair complete?	—	Go to Step 6	—
5	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 048 - Drive Motor Control Module Circuit

Circuit Description

The Drive Motor Control Module continuously monitors hardware registers on the processor in order to ensure they are in the correct state.

Conditions for Setting the DTC

- Drive Motor Control Module time protected memory register corruption is detected.

Action Taken When the DTC Sets

- The Drive Motor Control Module will flash the SERVICE SOON light.
- DTC will be stored in the failure records buffer.
- The processor is reset.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step verifies that the fault is present.

DTC 048 - Drive Motor Control Module Circuit

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault current?	—	Go to Step 3	Go to Diagnostic Aids
3	Replace the Power Inverter Module. Refer to *Power Inverter Module removal and reprogramming procedure.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD System Check*	—

DTC 049 - Drive Motor Control Module Circuit

Circuit Description

The Drive Motor Control Module continuously monitors a known value in order to detect corruption of its memory.

Conditions for Setting the DTC

- Drive Motor Control Module has detected a software stack overflow.

Action Taken When the DTC Sets

- The DTC will be stored in the failure records buffer.
- The Drive Motor Control Module processor will attempt to reset.
- The Drive Motor Control Module will flash the SERVICE SOON light each time the processor attempts to reset.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step verifies that the fault is present.

DTC 049 - Drive Motor Control Module Circuit

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault current?	—	Go to Step 3	Go to Diagnostic Aids
3	Replace the Drive Motor Control Module. Refer to *Power Inverter Module removal and reprogramming procedure.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD System Check*	—

DTC 050 - Drive Motor Control Module Circuit

Circuit Description

The Drive Motor Control Module continuously monitors processing time in order to detect delays.

Conditions for Setting the DTC

- Drive Motor Control Module detects a processing time overflow.

Action Taken When the DTC Sets

- The DTC will be stored in the failure records buffer.
- The Drive Motor Control Module processor will attempt to reset.
- The Drive Motor Control Module will flash the SERVICE SOON light each time the processor attempts to reset.

Conditions for Clearing the DTC

- The DTC can be cleared by using the scan tool Clear Info function after the fault is no longer present.

Diagnostic Aids

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step verifies that the fault is present.

DTC 050 - Drive Motor Control Module Circuit

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault present?	—	Go to Step 3	Go to Diagnostic Aids
3	Replace the Power Inverter Module. Refer to *Power Inverter Module removal and reprogramming procedure.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD System Check*	—

DTC 053 Battery Pack Reduced Performance

Circuit Description

The Drive Motor Control Module monitors the battery pack voltage continuously during operation. The Bias Control Assembly supplies an isolated, scaled (1v = 100v) battery voltage signal to the Drive Motor Control Module. This circuitry is internal to the Power Inverter Module. The Drive Motor Control Module also receives battery current information from the Battery Pack Control Module via the serial data link. The Drive Motor Control Module looks at battery voltage sag as a function of current in order to detect low battery power output capability.

Conditions for Setting the DTC

- Drive Motor Control Module sees excessive voltage sag as a function of battery current continuously for 30 seconds.

Action Taken When the DTC Sets

- DTC will be stored in the failure records buffer.

Conditions for Clearing the DTC

- Fault is latched for the duration of the ignition cycle or until the charge paddle is inserted into the charge receptacle.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- This DTC will always set with another code causing a reduced performance condition. Go to other DTC(s) to repair this fault.

Reviewing the Failure Records and SOC when the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition. Low SOC combined with heavy accelerations may cause this DTC to set.

Test Description

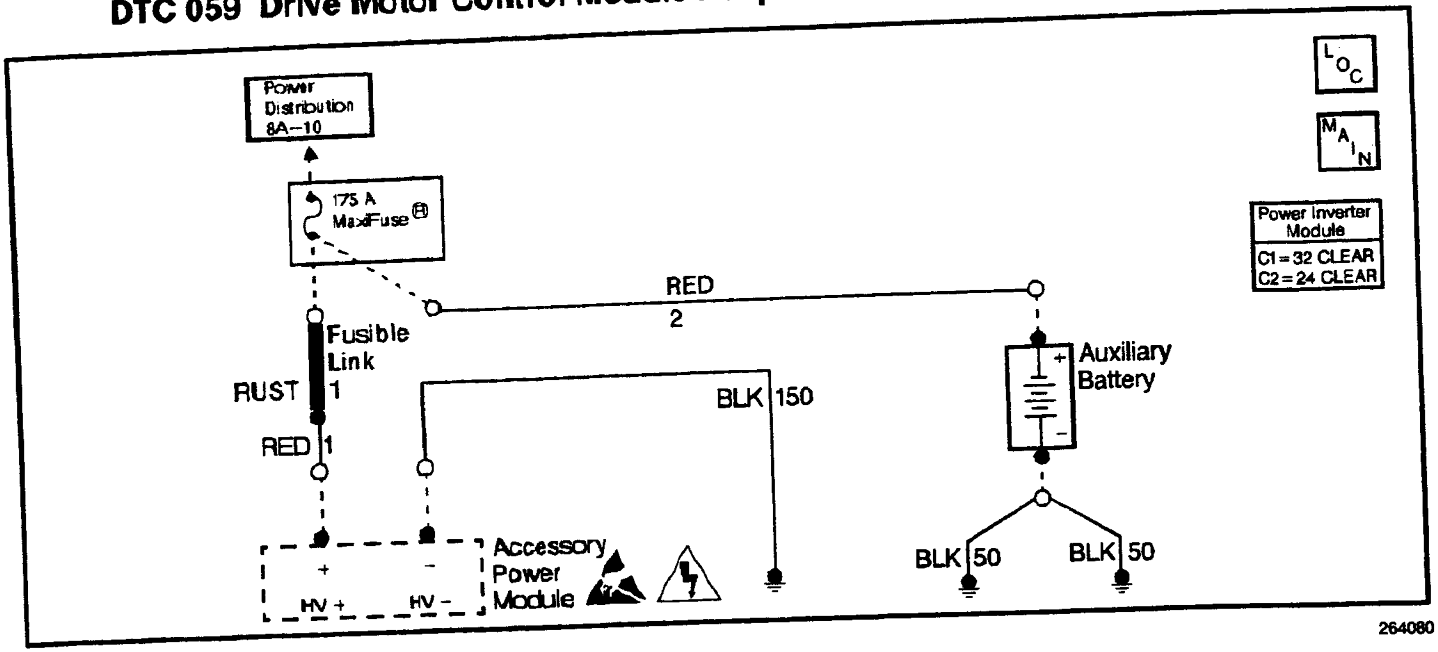
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This DTC serves as an information code. If DTC 053 sets this is an indication that the Battery Pack Control Module has requested the Drive Motor Control Module to place the vehicle into a reduced performance mode.

DTC 053 Battery Pack Reduced Performance

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Go to other DTC(s) first. Is the action complete?	—	Go to Step 3	Go to Diagnostic Aids
3	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 059 Drive Motor Control Module Keep Alive Memory Circuit Low Voltage



264080

Circuit Description

Whenever the Accessory Power Control Module is awake it provides a constant DC supply to the auxiliary battery which supplies power to the 12 volt system. This DC voltage keeps the auxiliary battery charged during vehicle operation. Normal operating voltage is 13.5 to 14.5 volts. The Drive Motor Control Module monitors the Run 1 (pin 19 of the Power Inverter Module 32-way connector) input to determine Aux. battery voltage.

Conditions for Setting the DTC

- Auxiliary battery voltage drops below 9 volts for 0.25 seconds.

Action Taken When the DTC Sets

- The Drive Motor Control Module will illuminate the SERVICE NOW light.
- DTC will be stored in the failure records buffer.
- Accelerator pedal input is disabled.
- Cruise control is disabled.

Conditions for Clearing the DTC

- The DTC will clear if the fault conditions are no longer present for 10 seconds but the APP input remains disabled until the next ignition cycle.
- DTC can be cleared by using the scan tool Clear Info function after the fault is no longer present.

Diagnostic Aids

Check for the following conditions:

- Inspect the positive and negative cables for tightens at the Accessory Power Control Module and the Aux. battery.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks the auxiliary battery voltage.
6. This step checks the voltage output from the Accessory Power Control Module.

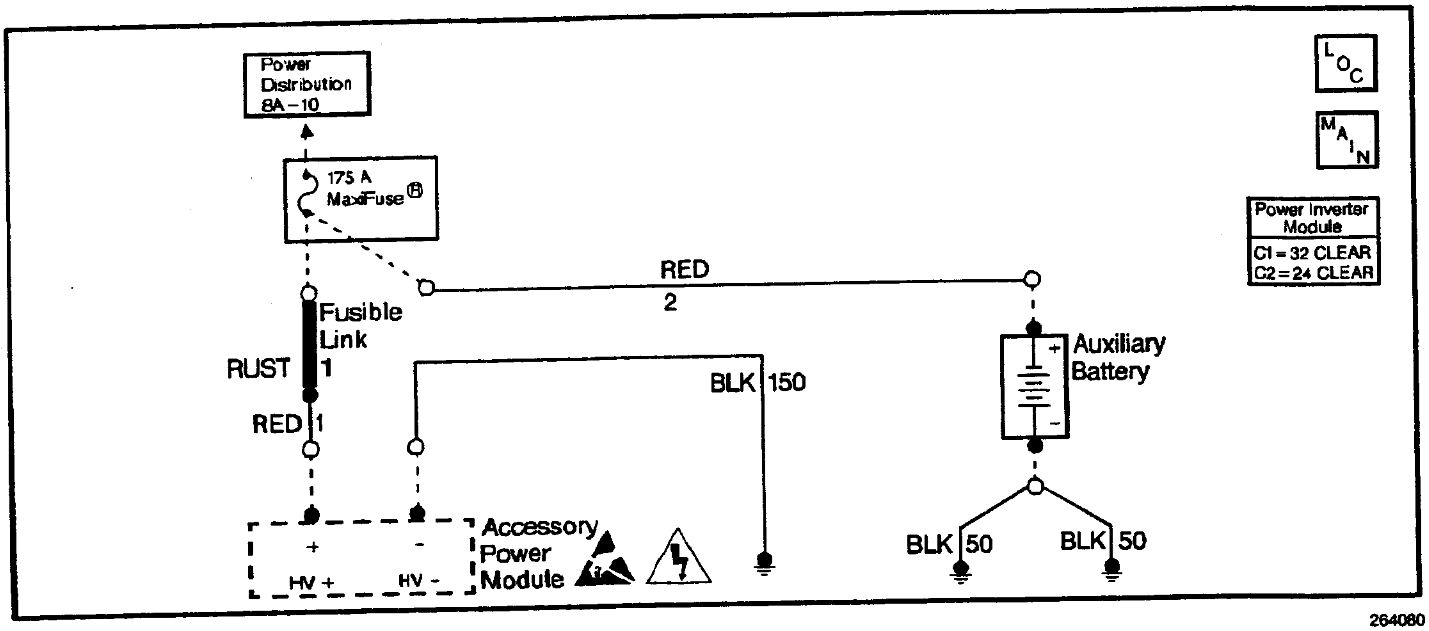
DTC 059 - Drive Motor Control Module Keep Alive Memory Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool view Drive Motor Control Module Aux. battery voltage. Is Drive Motor Control Module Aux. battery voltage at or above the specified value?	9.5 V	Go to Diagnostic Aids	Go to Step 3

DTC 059 - Drive Motor Control Module Keep Alive Memory Circuit Low Voltage (continued)

Step	Action	Value(s)	Yes	No
3	1. Turn the ignition ON. 2. Using a DMM, measure the voltage at the Aux. battery. Is the voltage at or above the specified value?	13 V	Go to Step 7	Go to Step 4
4	1. Turn the ignition OFF. 2. Using a DMM measure the voltage at the Aux. battery Does the DMM measure Aux. battery voltage at or below the specified value?	9.5 V	Go to Step 5	Go to Step 6
5	Charge and test the Aux. battery. Refer to *Auxiliary battery.* Did the Aux. battery pass the load test?	—	Go to Step 6	Go to Step 10
6	1. With the ignition OFF, Disconnect the positive Aux. battery cable at the Aux. battery. 2. Disconnect the positive Aux. battery cable at the Accessory Power Control Module. 3. Turn the ignition ON. 4. Using a DMM measure the voltage between the positive terminal at the Accessory Power Control Module and ground. Is the voltage at or above the specified value?	14 V	Go to Step 9	Go to Step 11
7	1. Turn the ignition OFF. 2. Disconnect the 32-way connector at the Power Inverter Module. 3. Turn the ignition ON. 4. Using a DMM measure the voltage at the 32-way connector terminal 19 to ground. Is the voltage at or above the specified value?	13 V	Go to Step 12	Go to Step 8
8	Repair high resistance in the Run 1 circuit to pin 19 of the Power Inverter Module 32-way connector. Refer to *8A for Run 1 power distribution.* Is the action complete?	—	Go to Step 13	—
9	Repair or replace positive or negative Aux. battery cables or connection. Is the action complete?	—	Go to Step 13	—
10	Replace the Aux. battery. Refer to *Aux. battery Removal and Installation procedure.* Is the action complete?	—	Go to Step 13	—
11	Replace the Accessory Power Control Module. Refer to *Accessory Power Control Module Removal and Installation procedure in this section.* Is the action complete?	—	Go to Step 13	—
12	Replace the faulty Drive Motor Control Module. Refer to Power Inverter Module replacement and programming procedures in this section. Is the action complete?	—	Go to Step 13	—
13	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 060 - Drive Motor Control Module Keep Alive Memory Circuit High Voltage


Power Distribution 8A-10
175 A MaxiFuse®
Fusible Link
RUST 1
RED 1
RED
2
BLK 150
Auxiliary Battery
+
-
BLK 50
BLK 50
Accessory Power Module
+
-
HV +
HV -
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR

264080

Circuit Description

Whenever the Accessory Power Control Module is awake it provides a constant DC supply to the auxiliary battery which supplies power to the 12 volt system. This DC voltage keeps the auxiliary battery charged during vehicle operation. Normal operating voltage is 13.5 to 14.5 volts. The Drive Motor Control Module monitors the Run 1 (terminal 19 of the PIM 32-way connector) input to determine Aux. battery voltage.

Conditions for Setting the DTC

- Auxiliary battery voltage increases above 20 volts for 0.25 seconds.

Action Taken When the DTC Sets

- The Drive Motor Control Module will illuminate the SERVICE NOW light.
- DTC will be stored in the failure records buffer.
- Accelerator pedal input is disabled.
- Cruise control is disabled.

Conditions for Clearing the DTC

- The DTC will clear if the fault conditions are no longer present for 10 seconds but the APP input remains disabled until the next ignition cycle.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

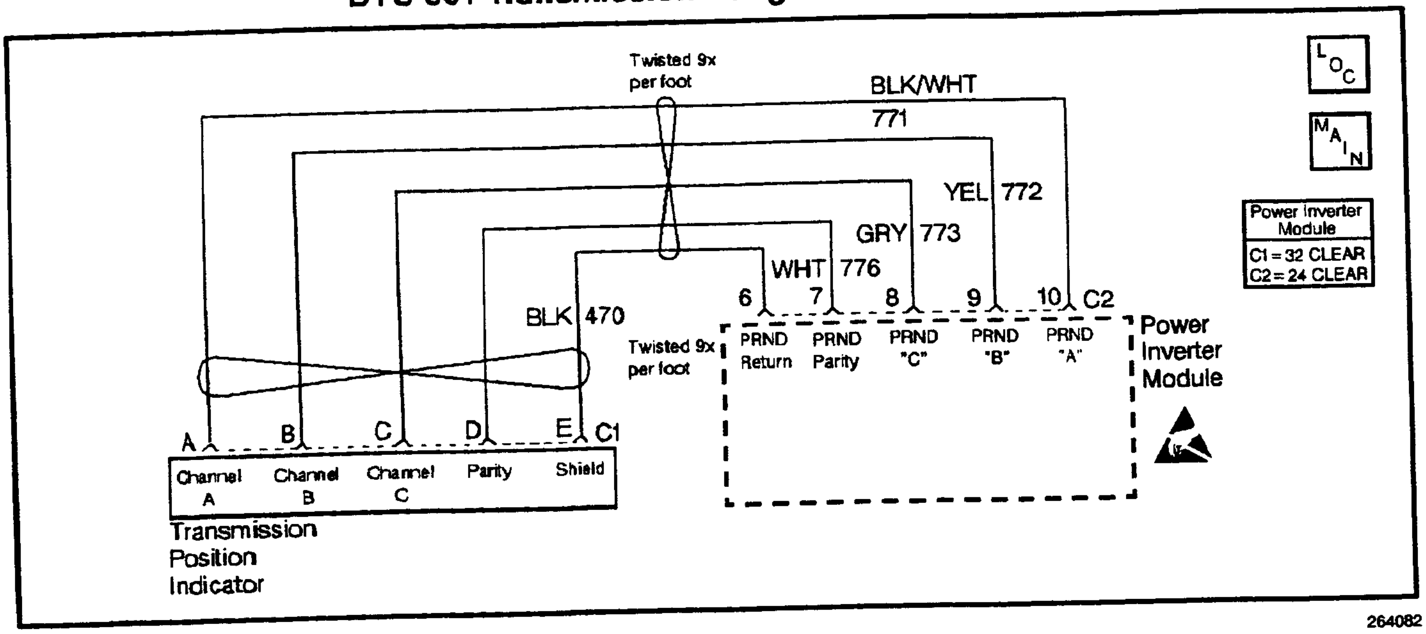
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step measures the voltage output from the Accessory Power Control Module to the auxiliary battery.

DTC 060 - Drive Motor Control Module Keep Alive Memory Circuit High Voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using the scan tool view Drive Motor Control Module Aux. battery voltage. Is Drive Motor Control Module Aux. battery voltage at or above the specified value?	20 V	Go to Step 3	Go to Diagnostic Aids
3	1. Turn the ignition ON. 2. Using a DMM, measure the voltage at the Aux. battery. Is the voltage at or above the specified value?	15 V	Go to Step 4	Go to Step 5
4	Replace the Accessory Power Control Module. Refer to *Accessory Power Control Module Removal and Installation procedure in this section.* Is the action complete?	—	Go to Step 6	—
5	Replace the faulty Drive Motor Control Module. Refer to Power Inverter Module replacement and programming procedures in this section. Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 061 Transmission Range Indicator Circuit


Twisted 9x per foot
BLK/WHT
771
YEL 772
GRY 773
WHT 776
BLK 470
6
7
8
9
10
C2
PRND Return
PRND Parity
PRND "C"
PRND "B"
PRND "A"
Power Inverter Module
Twisted 9x per foot
A
B
C
D
E
C1
Channel A
Channel B
Channel C
Parity
Shield
Transmission Position Indicator
LOC
MAIN
Power Inverter Module
C1=32 CLEAR
C2=24 CLEAR

264082

Circuit Description

The Drive Motor Control Module reads the transmission range switch position from an encoder which provides three signals plus a parity bit. Using this parity bit, the Drive Motor Control Module can detect a failure of any single switch.

Conditions for Setting the DTC

The transmission range switch input does not match one or more of the following valid components for 60 seconds:

- Park
- Reverse
- Neutral
- Drive

Action Taken When the DTC Sets

- The Drive Motor Control Module will request the vehicle to neutral
- DTC will be stored in the failure records buffer.

Conditions for Clearing the DTC

- The DTC will Clear after 10 seconds of a no fault condition.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

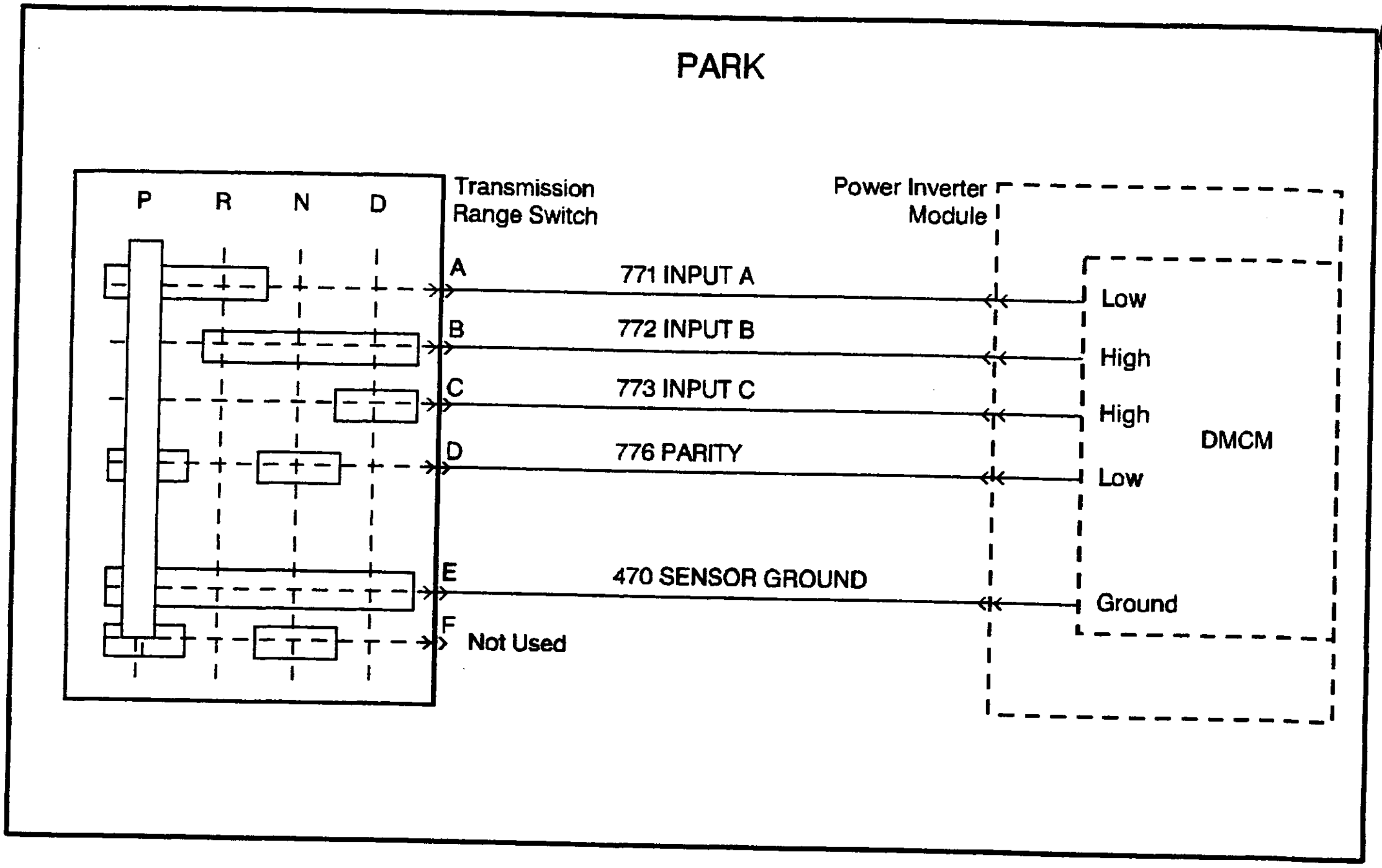
- Misalignment of transmission range switch cable.
- For transmission range switch adjustment procedures, refer to Transmission Range Indicator Switch Removal and Installation.
- Refer to the transmission range indicator switch circuit status table for normal transmission range values.
- Perform a visual inspection of the transmission range switch and connectors.
- Check for loose missing or damaged connector terminals.
- If scan tool displays all transmission range switch inputs are high, check for an open in the sensor ground circuit 470.
- If the shifter is held for one minute between gear positions this DTC will set. This is a normal condition.

TRANSMISSION RANGE INDICATOR SWITCH CIRCUIT STATUS TABLE (Normal Operation)

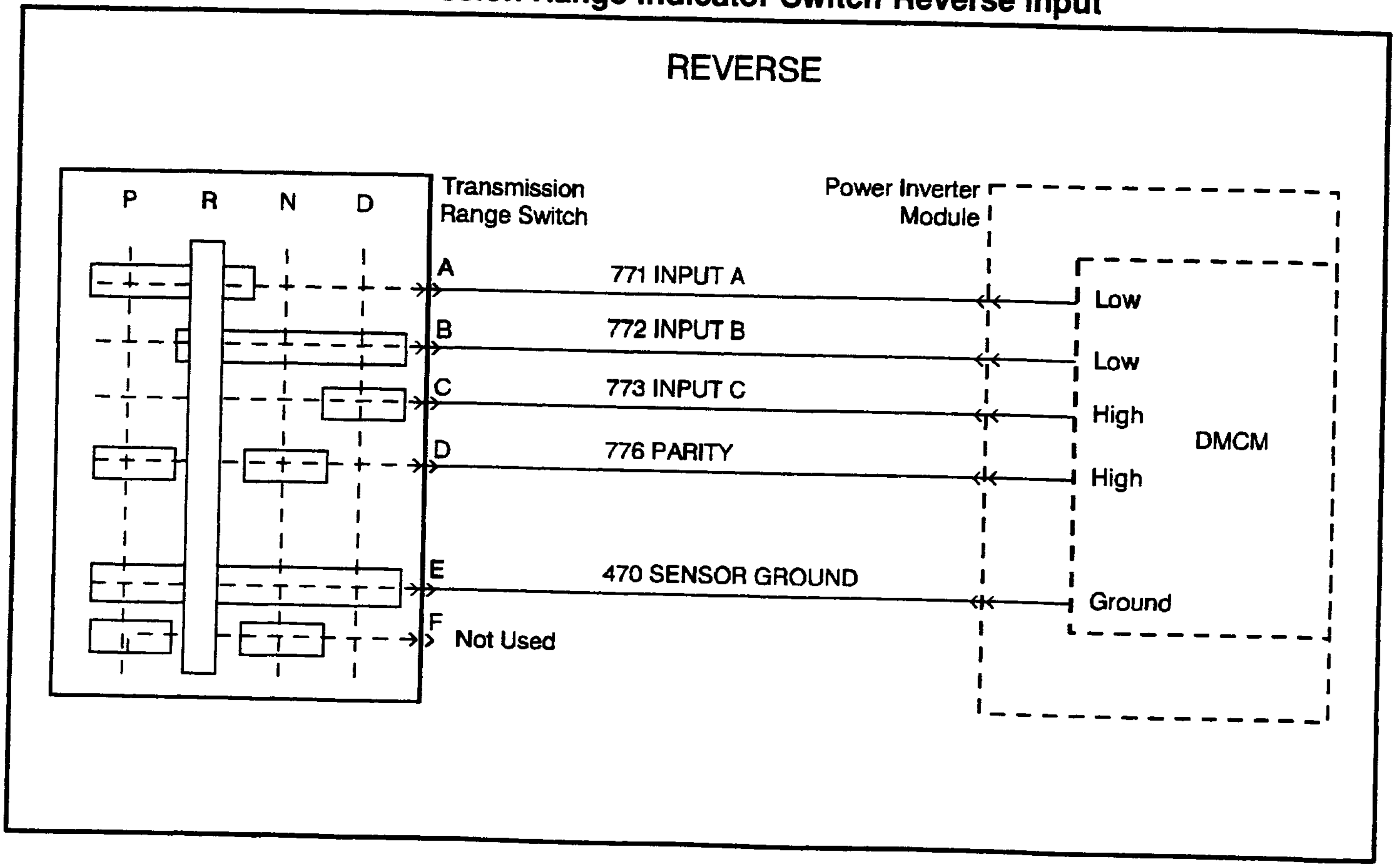
TRANSMISSION RANGE SELECTED	INPUT A CIRCUIT 771	INPUT B CIRCUIT 772	INPUT C CIRCUIT 773	PARITY (P) CIRCUIT 776
PARK	LOW	HIGH	HIGH	LOW
REVERSE	LOW	LOW	HIGH	HIGH
NEUTRAL	HIGH	LOW	HIGH	LOW
DRIVE	HIGH	LOW	LOW	HIGH

LOW=GROUNDED THROUGH CIRCUIT 470
HIGH=OPEN(not grounded)

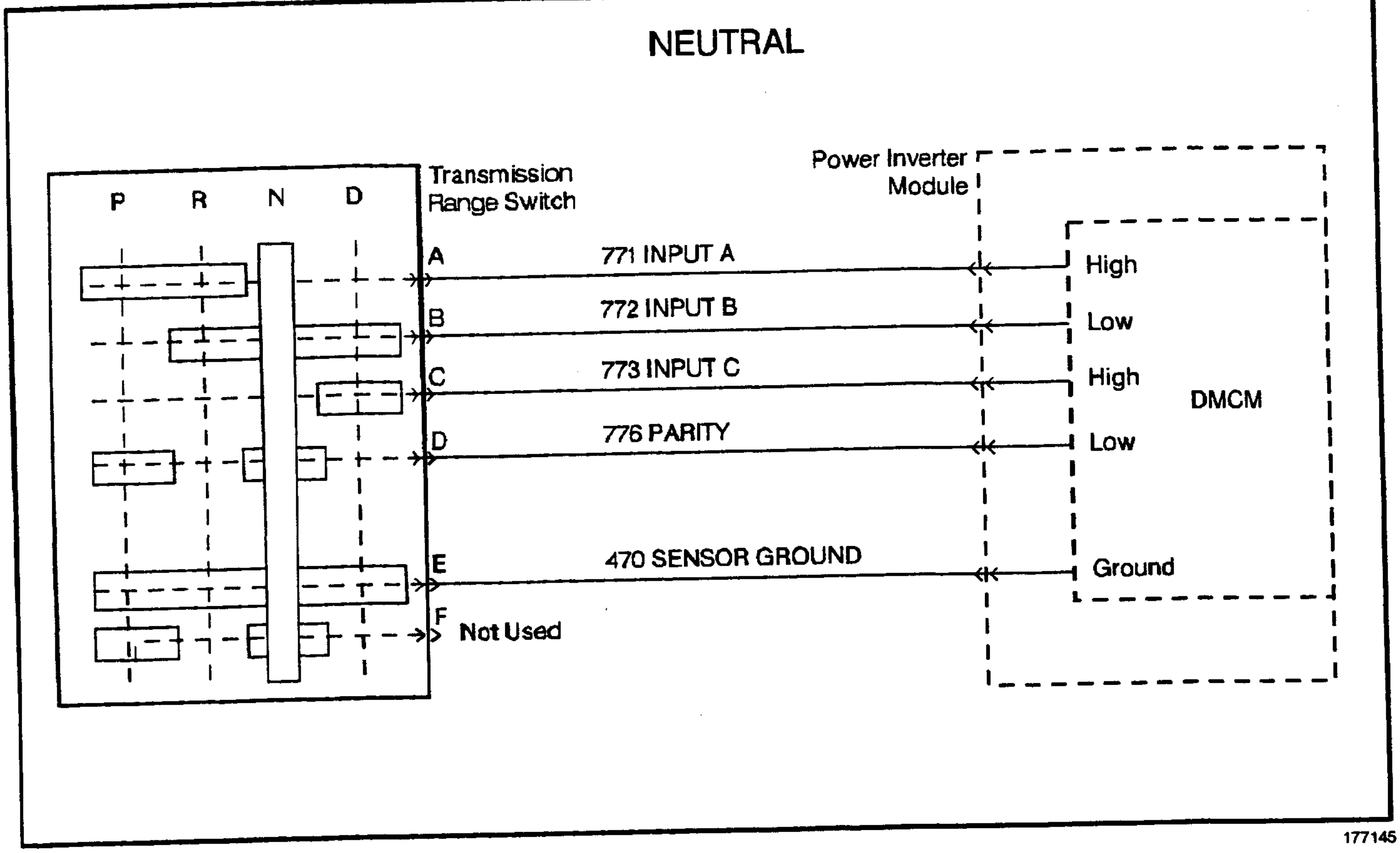
Transmission Range Indicator Switch Park Input


PARK
P
R
N
D
Transmission Range Switch
Power Inverter Module
A
771 INPUT A
Low
B
772 INPUT B
High
C
773 INPUT C
High
DMCM
D
776 PARITY
Low
E
470 SENSOR GROUND
Ground
F
Not Used
177137

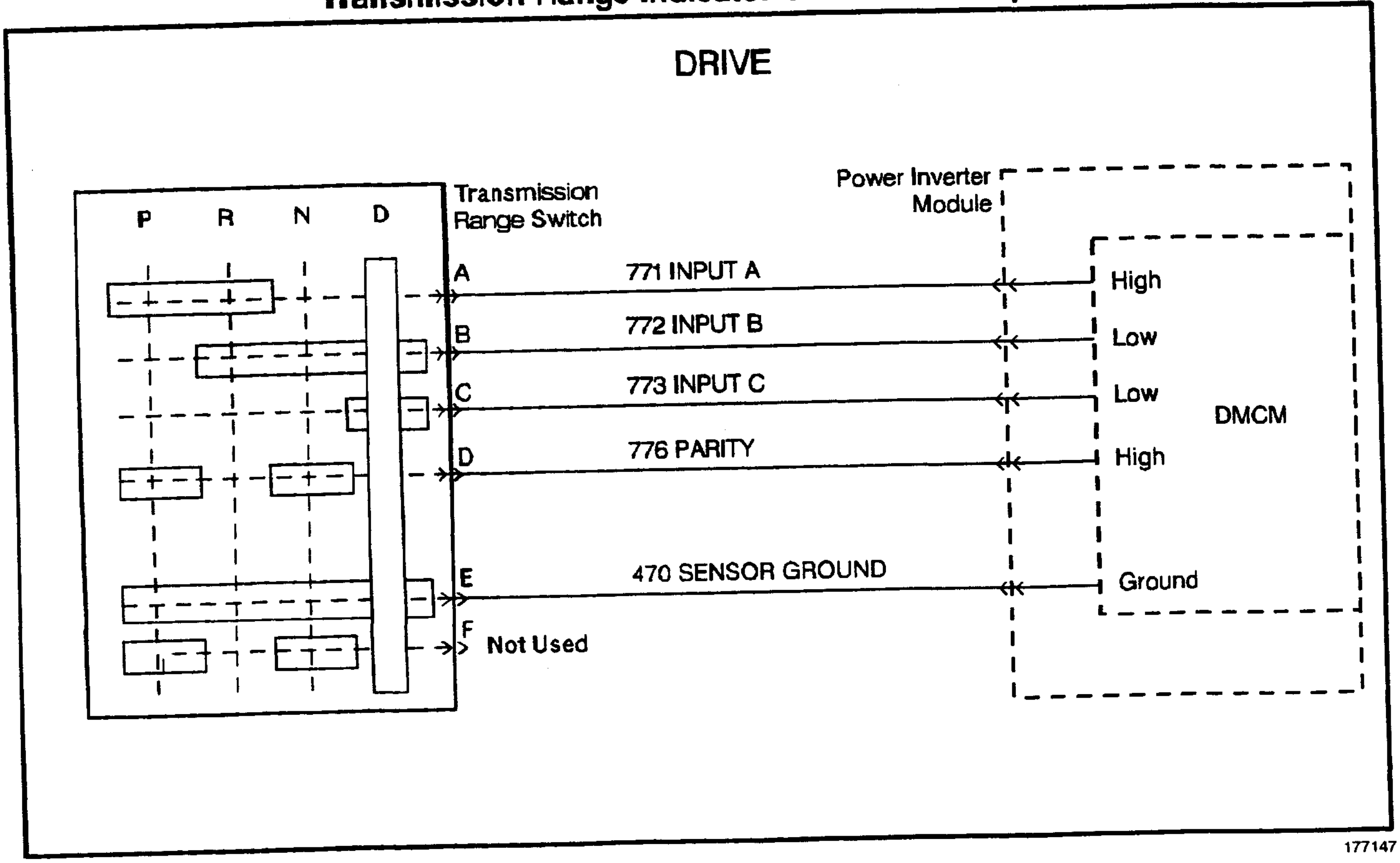
Transmission Range Indicator Switch Reverse Input


REVERSE
P
R
N
D
Transmission Range Switch
Power Inverter Module
A
771 INPUT A
Low
B
772 INPUT B
Low
C
773 INPUT C
High
DMCM
D
776 PARITY
High
E
470 SENSOR GROUND
Ground
F
Not Used
177141

Transmission Range Indicator Switch Neutral Input


NEUTRAL
P
R
N
D
Transmission
Range Switch
Power Inverter
Module
A
771 INPUT A
High
B
772 INPUT B
Low
C
773 INPUT C
High
DMCM
D
776 PARITY
Low
E
470 SENSOR GROUND
Ground
F
Not Used
177145

Transmission Range Indicator Switch Drive Input


DRIVE
P
R
N
D
Transmission
Range Switch
Power Inverter
Module
A
771 INPUT A
High
B
772 INPUT B
Low
C
773 INPUT C
Low
DMCM
D
776 PARITY
High
E
470 SENSOR GROUND
Ground
F
Not Used
177147

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Clears the DTC.
3. Checks to see if the fault is present.
15. Checks for grounded T/R Switch input circuits.
21. Checks for open T/R Switch input circuits.

DTC 061 Transmission Range Indicator Circuit

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the ignition switch ON. 2. Connect the scan tool. 3. Read and record current and history DTC(s). 4. Clear DTC(s) 5. Cycle the ignition OFF and then back ON. Is the action complete?	—	Go to Step 3	—
3	1. Depress and hold the brake pedal. 2. Place the gear selector in the P, R, N, and D positions for the specified time value in each position. Did the DTC(s) reset?	65 seconds	Go to Step 4	Go to *Diagnostic Aids*
4	1. Using a scan tool, select Drive Motor Control Module Data. 2. View and record the T/R Switch Input values A, B, C and P while shifting through P, R, N, and D. Do all four T/R Switch inputs read HIGH in all positions?	—	Go to Step 20	Go to Step 5
5	Do all four T/R Switch input values A, B, C and P read LOW in all positions?	—	Go to Step 15	Go to Step 6
6	Does Transmission Range Input A read HIGH in all positions?	—	Go to Step 18	Go to Step 7
7	Does Transmission Range Input A read LOW in all positions?	—	Go to Step 19	Go to Step 8
8	Does Transmission Range Input B read HIGH in all positions?	—	Go to Step 17	Go to Step 9
9	Does Transmission Range Input B read LOW in all positions?	—	Go to Step 19	Go to Step 10
10	Does Transmission Range Input C read HIGH in all positions?	—	Go to Step 16	Go to Step 11
11	Does Transmission Range Input C read LOW in all positions?	—	Go to Step 19	Go to Step 12
12	Does Transmission Range Input P read HIGH in all positions?	—	Go to Step 14	Go to Step 13
13	Does Transmission Range Input P read LOW in all positions?	—	Go to Step 19	Go to Diagnostic Aids
14	1. Vehicle in Park. 2. Disconnect the T/R Switch 6-way connector. 3. Use the scan tool to view T/R Switch inputs. 4. With a test light to ground probe the T/R Switch 6-way harness connector(harness side) terminal D. Does T/R Input P Display LOW?	—	Go to Step 28	Go to Step 24

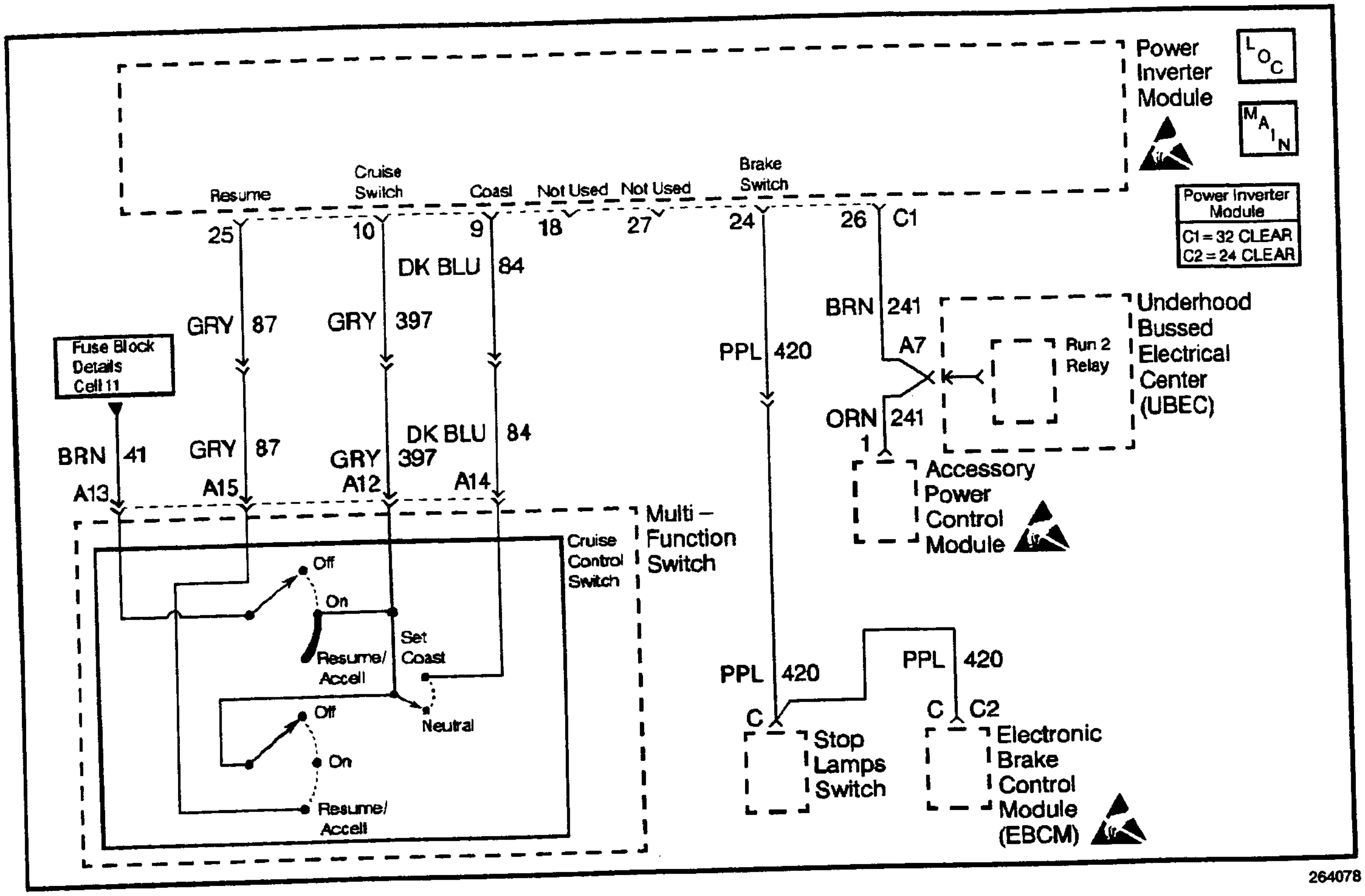
DTC 061 Transmission Range Indicator Circuit (continued)

Step	Action	Value(s)	Yes	No
15	1. Vehicle in Park. 2. Disconnect the T/R Switch 6-way connector. 3. Use the scan tool to view the T/R Switch Input values A, B, C and P. Do all four T/R Inputs Display HIGH?	—	Go to Step 33	Go to Step 27
16	1. Disconnect the T/R Switch 6-way connector. 2. With a test light to ground probe the T/R Switch 6-way harness connector(harness side) terminal C. Does T/R Input C Display LOW?	—	Go to Step 28	Go to Step 23
17	1. Disconnect the T/R Switch 6-way connector. 2. With a test light to ground, probe the T/R Switch 6-way harness connector(harness side) terminal B. Does T/R Input B Display LOW?	—	Go to Step 28	Go to Step 22
18	1. Disconnect the T/R Switch 6-way connector. 2. With a test light to ground, probe the T/R Switch 6-way harness connector(harness side) terminal A. Does T/R Input A Display LOW?	—	Go to Step 28	Go to Step 21
19	1. Disconnect the T/R Switch 6-way connector. 2. Using the scan tool view the T/R Switch input values. Does T/R Switch input values A, B, C and P Display HIGH?	—	Go to Step 33	Go to Step 27
20	1. Vehicle in Park. 2. Disconnect the T/R Switch 6-way connector. 3. Use the scan tool to view T/R Switch inputs. 4. With a test light to ground probe the T/R Switch 6-way harness connector(harness side) terminals A, B, C and D. Do all four T/R switch input values display LOW when grounded through the test light?	—	Go to Step 25	Go to Step 29
21	Check circuit 771 for a poor connection/open circuit. Did you find a poor connection or open circuit?	—	Go to Step 31	Go to Step 32
22	Check circuit 772 for a poor connection/open circuit. Did you find a poor connection or open circuit?	—	Go to Step 31	Go to Step 32
23	Check circuit 773 for a poor connection/open circuit. Did you find a poor connection or open circuit?	—	Go to Step 31	Go to Step 32
24	Check circuit 776 for a poor connection/open circuit. Did you find a poor connection or open circuit?	—	Go to Step 31	Go to Step 32
25	1. Disconnect the T/R Switch 6-way connector. 2. Use the scan tool to view T/R Switch inputs. 3. With a test light to 12 volts, probe the T/R Switch 6-way harness connector(harness side) terminal E. Did the test light turn ON?	—	Go to Step 28	Go to Step 26
26	Check circuit 470 for a poor connection/open circuit. Did you find a poor connection or open circuit?	—	Go to Step 31	Go to Step 32
27	Check for grounded wires on circuits 771,772, 773 and 776. Was a problem found?	—	Go to Step 31	Go to Step 32

DTC 061 Transmission Range Indicator Circuit (continued)

Step	Action	Value(s)	Yes	No
28	Check for poor connections at the Transmission Range Indicator Switch. Was a poor connection found?	—	Go to Step 31	Go to Step 33
29	Repair open in the circuit(s) that did not display LOW when grounded through the test light. Is the repair complete?	—	Go to Step 34	—
30	Check for shorts between any of the pins at the Transmission Range Indicator Switch and at the Power Inverter Module 24-way connector. Was a problem found?	—	Go to Step 31	Go to *Diagnostic Aids*
31	Repair the circuit as needed. Refer to *Electrical Diagnosis.* Is the repair complete?	—	Go to Step 34	—
32	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation.* **IMPORTANT:** When a new drive motor Power Inverter Module is installed the correct software and calibration must be downloaded before vehicle will operate. Is the repair complete?	—	Go to Step 34	—
33	Replace the Transmission Range Indicator Switch. Refer to *Transmission Range Indicator Switch Removal and Installation.* Is the repair complete?	—	Go to Step 34	—
34	Clear DTCs. Refer to *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 062 Cruise Set Circuit


Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Resume
Cruise Switch
Coast
Not Used
Not Used
Brake Switch
25
10
9
18
27
24
26
C1
DK BLU 84
GRY 87
GRY 397
BRN 241
PPL 420
A7
Underhood Bussed Electrical Center (UBEC)
Run 2 Relay
ORN 241
1
Accessory Power Control Module
Fuse Block Details Cell 11
BRN 41
GRY 87
GRY 397
DK BLU 84
A13
A15
A12
A14
Multi – Function Switch
Cruise Control Switch
Off
On
Resume/ Accel
Set Coast
Neutral
Off
On
Resume/ Accel
PPL 420
PPL 420
C
C
C2
Stop Lamps Switch
Electronic Brake Control Module (EBCM)
264078

Circuit Description

The Drive Motor Control Module reads three cruise control switch inputs: set/coast, resume/accel, and ON/OFF. The set/coast switch and the resume/accel switch are momentary switches. When the DMCM detects the set/coast switch is high for a calibrated period of time a DTC will set.

Conditions for Setting the DTC

- Set/resume switch is greater than 3.5 volts for longer than 60 seconds.

Action Taken When the DTC Sets

- The Drive Motor Control Module will disable cruise.
- The DTC will be stored in failure records.

Conditions for Clearing the MIL/DTC

- The DTC requires one ignition cycle before the code can be cleared.
- The DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- If the Set/Coast switch is stuck in the ON position or the driver is holding the Set/Coast switch ON for longer than 60 seconds, DTC will set. DTC only checks the signal circuit for a short to voltage.
- Check Power Inverter Module 32-way connector and cruise switch connectors for bent or backed out pins, or other damage.
- Pressing on the set/coast switch with excessive pressure may cause the switch to stick in the depressed position. This is normal operation and the switch should not be replaced for this condition.

Test Description

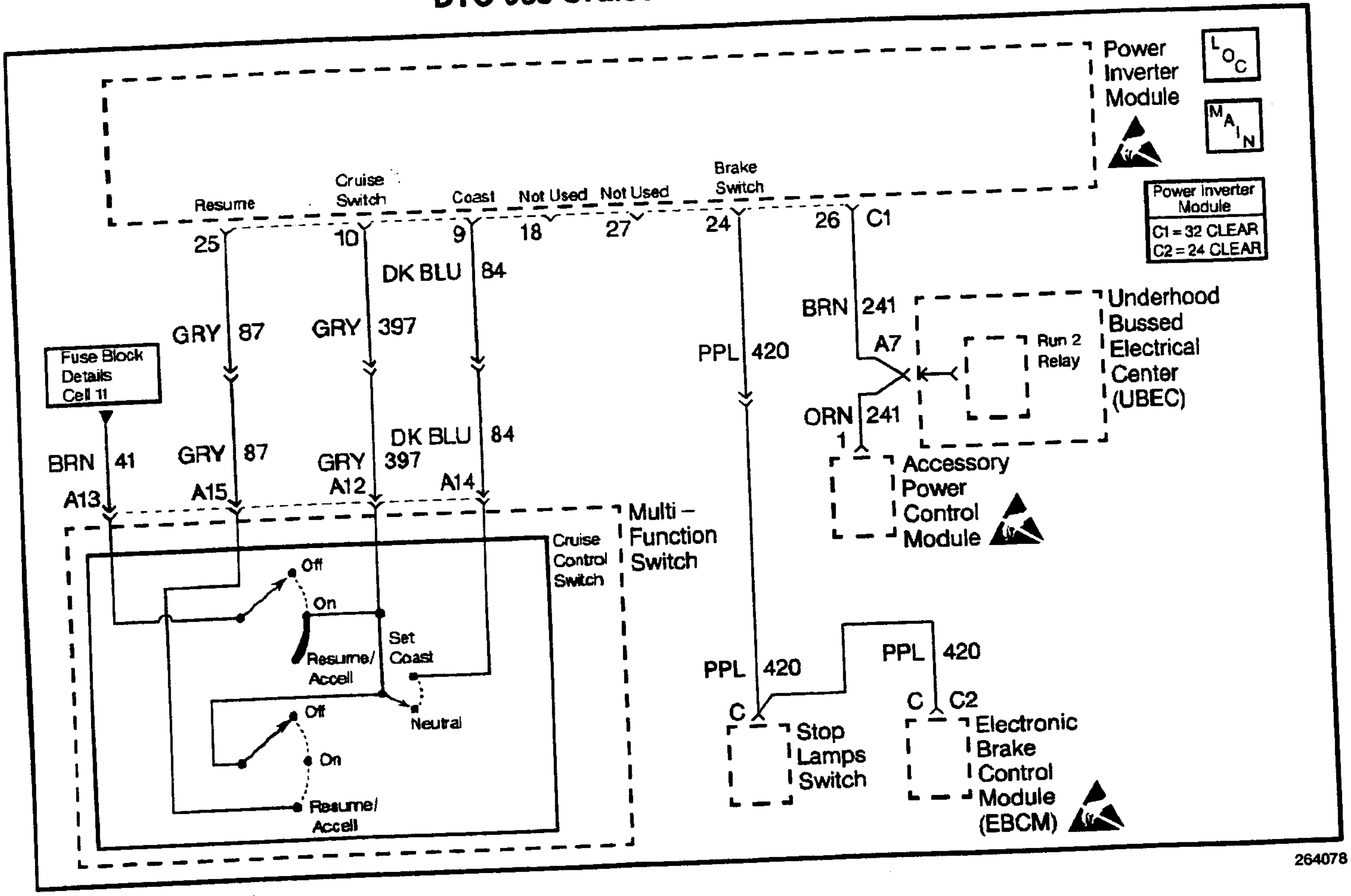
Number(s) below refer to the Step number(s) on the Diagnostic Table.

3. This step checks the Set/Coast switch signal circuit for a short to 12 volts.

DTC 062 Cruise Set Circuit

Step	Action	Value(s)	Yes	No
1	Was the *On-Board Diagnostic (OBD) System Check* performed?	—	Go to Step 2	Go to *OBD System Check.*
2	1. Scan tool connected. 2. Turn the ignition ON. 3. Turn the cruise switch OFF Does scan tool display Set switch ON?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Ignition ON. 2. Disconnect the Power Inverter Module 32-way connector. 3. Probe the Set switch signal circuit 84 at terminal 9 of the Power Inverter Module harness with a test light connected to chassis ground. Is the test light ON?	—	Go to Step 4	Go to Step 7
4	1. Disconnect the cruise control lever connector. 2. Probe the Set switch signal circuit 84 at pin 9 the Power Inverter Module harness with a test light connected to chassis ground. Is the test light ON?	—	Go to Step 5	Go to Step 6
5	1. Set switch signal circuit is shorted to auxiliary battery voltage. 2. Repair as necessary. Is the action complete?	—	Go to Step 8	—
6	Replace the cruise Multifunction switch. Refer to Steering column unit repair. Is the action complete ?	—	Go to Step 8	—
7	Replace the faulty Drive Motor Control Module. Refer to Power Inverter Module replacement and programming procedures in this section. Is the action complete ?	—	Go to Step 8	—
8	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 063 Cruise Resume Circuit


Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Resume
Cruise Switch
Coast
Not Used
Not Used
Brake Switch
25
10
9
18
27
24
26
C1
DK BLU 84
GRY 87
GRY 397
BRN 241
A7
Run 2 Relay
Underhood Bussed Electrical Center (UBEC)
PPL 420
ORN 241
1
Accessory Power Control Module
Fuse Block Details Cell 11
BRN 41
A13
GRY 87
A15
GRY 397
A12
DK BLU 84
A14
Multi-Function Switch
Cruise Control Switch
Off
On
Resume/Accell
Set Coast
Neutral
Off
On
Resume/Accell
PPL 420
PPL 420
C
C
C2
Stop Lamps Switch
Electronic Brake Control Module (EBCM)
264078

Circuit Description

The Drive Motor Control Module reads three cruise control switch inputs: set/coast, resume/accel, and ON/OFF. The set/coast switch and the resume/accel switch are momentary switches. When the Drive Motor Control Module detects the resume/accel switch is high for a calibrated period of time a DTC will set.

Conditions for Setting the DTC

- Resume switch voltage 3.5 volts for longer than 60 seconds.

Action Taken When the DTC Sets

- The Drive Motor Control Module will disallow all cruise inputs.
- The DTC will be stored in failure records.

Conditions for Clearing the MIL/DTC

- The DTC requires one ignition cycle before the code can be cleared.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Check for a resume/accel switch stuck in the engage position or the signal circuit is shorted to voltage.
- Check Power Inverter Module 32-way connector and cruise switch connectors for bent or backed out pins, or other damage.

Test Description

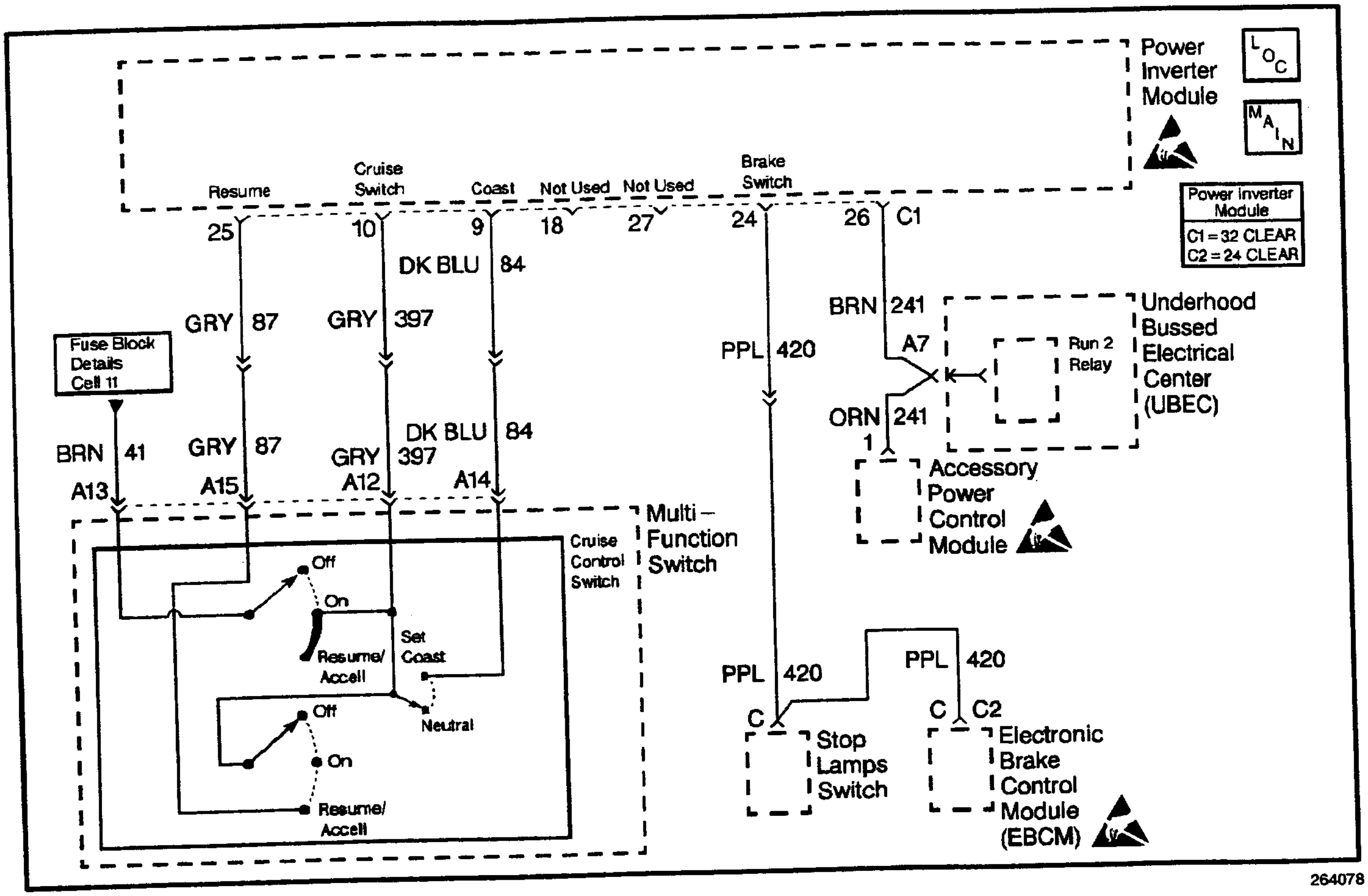
Number(s) below refer to the Step number(s) on the Diagnostic Table.

3. This step checks the Resume/Accel switch signal circuit for a short to 12 volts.

DTC 063 Cruise Resume Circuit

Step	Action	Value(s)	Yes	No
1	Was the *On-Board Diagnostic (OBD) System Check* performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Scan tool connected. 2. Turn the ignition ON. 3. Turn the cruise switch OFF Does scan tool display Resume switch ON?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Disconnect the Power Inverter Module 32-way connector. 2. Probe the Set switch signal circuit 87 at pin 25 the Power Inverter Module harness with a test light connected to chassis ground. Is the test light ON?	—	Go to Step 4	Go to Step 7
4	1. Disconnect the cruise control lever connector. 2. Probe the Set switch signal circuit 87 at pin 25 the Power Inverter Module harness with a test light connected to chassis ground. Is the test light ON?	—	Go to Step 5	Go to Step 6
5	Resume switch signal circuit is shorted to auxiliary battery voltage. Repair as necessary. Is the action complete?	—	Go to Step 8	—
6	Replace the cruise Multifunction switch. Refer to Steering column unit repair. Is the action complete?	—	Go to Step 8	—
7	Replace the faulty Drive Motor Control Module. Refer to Power Inverter Module replacement and programming procedures in this section. Is the action complete?	—	Go to Step 8	—
8	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 065 - Cruise Set Circuit High at Power-up


Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Resume
Cruise Switch
Coast
Not Used
Not Used
Brake Switch
25
10
9
18
27
24
26
C1
DK BLU 84
GRY 87
GRY 397
BRN 241
PPL 420
A7
Run 2 Relay
Underhood Bussed Electrical Center (UBEC)
ORN 241
1
Accessory Power Control Module
Fuse Block Details Cell 11
BRN 41
A13
GRY 87
A15
GRY 397
A12
DK BLU 84
A14
Multi-Function Switch
Cruise Control Switch
Off
On
Resume/ Accell
Set Coast
Neutral
Off
On
Resume/ Accell
PPL 420
PPL 420
C
C
C2
Stop Lamps Switch
Electronic Brake Control Module (EBCM)

264078

Circuit Description

The Drive Motor Control Module reads three cruise control switch inputs: set/coast, resume/accel, and on/off. The set/coast and resume/accel switches are wired through the on/off switch so that they are forced low whenever the on/off switch is in the off position. The Drive Motor Control Module checks the state of the set/coast switches at power-up to tell when the on/off switch is off to ensure that they are all low.

Conditions for Setting the DTC

- The set/coast switch is high and the on/off switch is low at power-up.

Action Taken When the DTC Sets

- The DTC will be stored in the failure records buffer.
- Cruise control is disabled.
- The fault is latched through the current ignition cycle.

Conditions for Clearing the DTC

- If the test is passed cruise will be enabled on the next ignition cycle.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure Records vehicle mileage since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

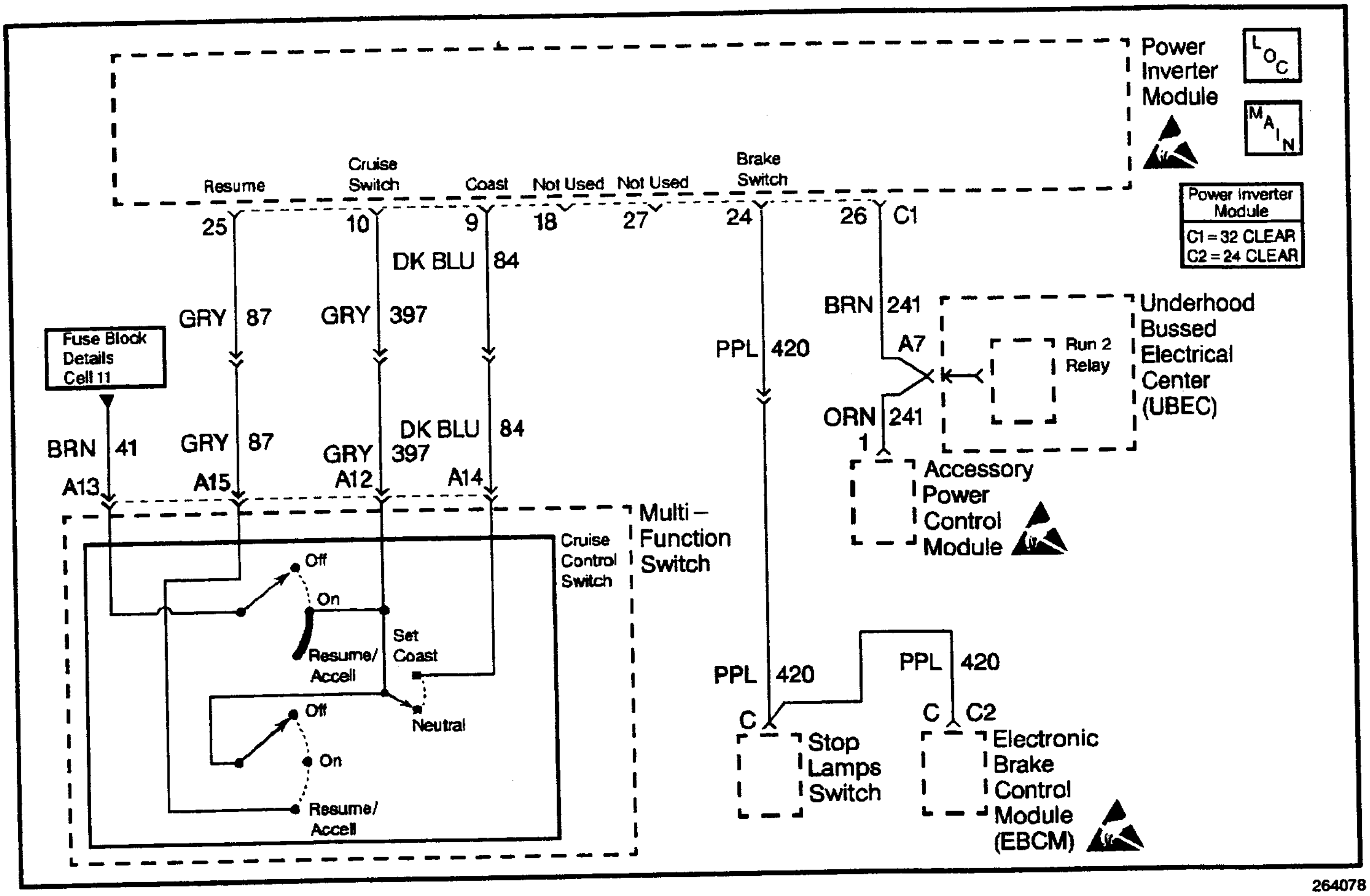
Number(s) below refer to the step number(s) on the Diagnostic Table.

4. This step checks the Set/Coast switch signal circuit for a short to 12 volts.

DTC 065 - Cruise Set Circuit High at Power-up

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is a Drive Motor Control Module DTC 062 also set?	—	Go to other DTC first	Go to Step 3
3	1. Scan tool connected. 2. Turn the ignition ON. 3. Turn the Cruise switch OFF. Does scan tool display Set switch ON?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Turn the ignition OFF. 2. Disconnect the Power Inverter Module 32-way connector. 3. Probe the Set switch signal circuit 84 at pin 9 the Power Inverter Module harness with a test light connected to chassis ground. Is the test light ON?	—	Go to Step 5	Go to Step 6
5	Set switch signal circuit is shorted to auxiliary battery voltage. Repair as necessary. Is the action complete?	—	Go to Step 7	—
6	Replace the faulty Drive Motor Control Module. Refer to Power Inverter Module replacement and programming procedures in this section. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 067 - Cruise Resume Circuit High at Power-up


Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Resume
Cruise Switch
Coast
Not Used
Not Used
Brake Switch
25
10
9
18
27
24
26
C1
DK BLU 84
GRY 87
GRY 397
PPL 420
BRN 241
A7
Run 2 Relay
Underhood Bussed Electrical Center (UBEC)
Fuse Block Details Cell 11
BRN 41
A13
GRY 87
A15
GRY 397
A12
DK BLU 84
A14
ORN 241
1
Accessory Power Control Module
Multi–Function Switch
Cruise Control Switch
Off
On
Resume/ Accell
Set Coast
Neutral
Off
On
Resume/ Accell
PPL 420
C
Stop Lamps Switch
PPL 420
C C2
Electronic Brake Control Module (EBCM)
264078

Circuit Description

The Drive Motor Control Module reads three cruise control switch inputs: set/coast, resume/accel, and on/off. The set/coast and resume/accel switches are wired through the on/off switch so that they are forced low whenever the on/off switch is in the off position. The Drive Motor Control Module checks the state of the set/coast switches at power-up to tell when the on/off switch is off to ensure that they are all low.

Conditions for Setting the DTC

- The resume/accel switch is high and the on/off switch is low at power-up.

Action Taken When the DTC Sets

- The DTC will be stored in the failure records buffer.
- Cruise control is disabled.

Conditions for Clearing the DTC

- The fault is latched through the current ignition cycle.
- If the test is passed cruise will be enabled on the next ignition cycle.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

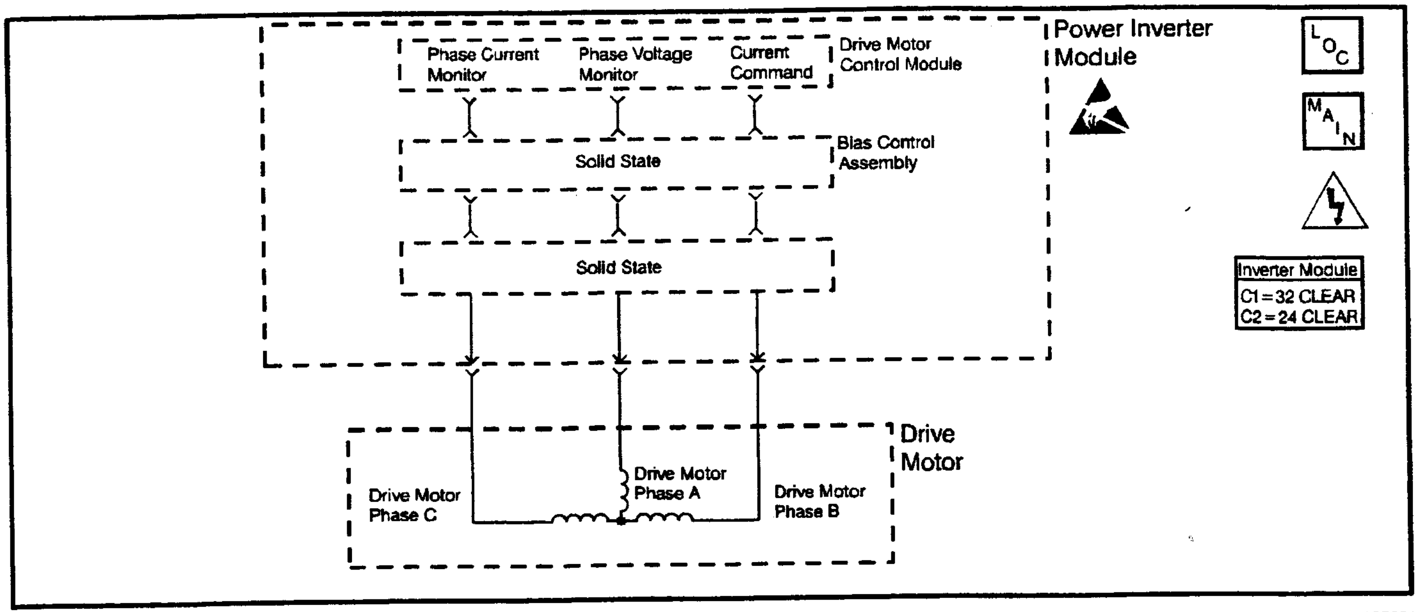
Number(s) below refer to the step number(s) on the Diagnostic Table.

4. This step checks the Resume/Accel switch signal circuit for a short to 12 volts.

DTC 067 - Cruise Resume Circuit High at Power-up

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is a Drive Motor Control Module DTC 063 also set?	—	Go to other DTC first	Go to Step 3
3	1. Scan tool connected. 2. Ignition ON. 3. Cruise switch OFF Does scan tool display Resume switch ON?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Ignition OFF. 2. Disconnect the PIM 32-way connector. 3. Probe the Resume switch signal circuit 87 at terminal 25 the Power Inverter Module harness with a test light connected to chassis ground. Is the test light ON?	—	Go to Step 5	Go to Step 6
5	1. Resume switch signal circuit is shorted to voltage. 2. Repair as necessary. Is the action complete?	—	Go to Step 7	—
6	Replace the faulty Drive Motor Control Module. Notice: If the Drive Motor Control Module is faulty, the new Drive Motor Control Module must be programmed. Refer to Power Inverter Module replacement and programming procedures. Is the action complete ?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 069 Power Inverter Module Phase Current Circuit High at Power-up


Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Power Inverter Module
Solid State
Bias Control Assembly
Solid State
Drive Motor Phase C
Drive Motor Phase A
Drive Motor Phase B
Drive Motor
LOC
MAIN
Inverter Module
C1=32 CLEAR
C2=24 CLEAR

125881

Circuit Description

The BCA generates the three motor phase currents in response to a command received from the Drive Motor Control Module. It also provides a feedback signal to the Drive Motor Control Module which is proportional to the peak value of one of the phase currents. During the power-up sequence with power supply commanded off and the current of 0, this output is tested to ensure that it is zero.

Conditions for Setting the DTC

- The Drive Motor Control Module sees a non zero value on the phase current feedback input during the power-up test.

Action Taken When the DTC Sets

- The Drive Motor Control Module illuminates the SERVICE NOW light.
- DTC will be stored in failure records buffer.
- Propulsion is disabled.

Conditions for Clearing the DTC

- The fault is latched through the current ignition cycle.
- The DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

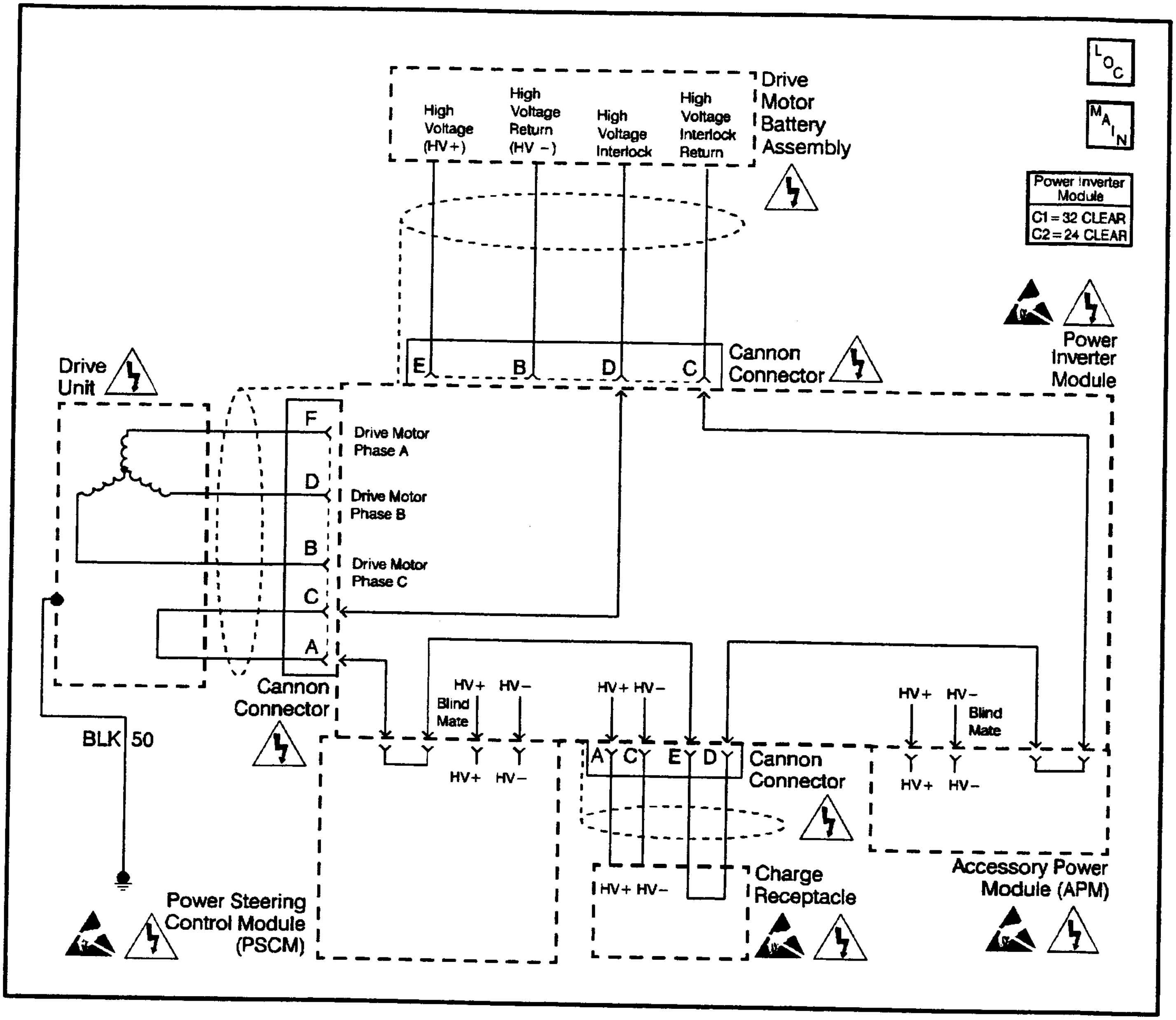
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This DTC is caused by an internal Power Inverter Module fault.

DTC 069 Power Inverter Module Phase Current Circuit High at Power-up

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault current?	—	Go to Step 3	Go to Diagnostic Aids
3	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to *OBD System Check*	—

DTC 070 - High Voltage Interlock Circuit


Drive Motor Battery Assembly
High Voltage (HV+)
High Voltage Return (HV -)
High Voltage Interlock
High Voltage Interlock Return
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Power Inverter Module
Cannon Connector
E
B
D
C
Drive Unit
F
Drive Motor Phase A
D
Drive Motor Phase B
B
Drive Motor Phase C
C
A
Cannon Connector
BLK
50
HV+
HV-
Blind Mate
HV+
HV-
A C E D
Cannon Connector
HV+
HV-
Blind Mate
Power Steering Control Module (PSCM)
HV+ HV-
Charge Receptacle
Accessory Power Module (APM)

264075

Circuit Description

The Drive Motor Control Module receives two inputs which indicate the status of the high voltage interlock loop. The Drive Motor Control Module continuously monitors these inputs so that it can immediately disable propulsion if a open in the interlock circuit occurs before the auto-disconnect opens the high voltage relays to prevent damage to components on the high voltage bus.

Conditions for Setting the DTC

- If either of the two high voltage interlock inputs indicate a fault.

Action Taken When the DTC Sets

- DTC is stored in failure records buffer.
- Propulsion is disabled.

Conditions for Clearing the DTC

- Both Drive Motor Control Module high voltage interlock inputs indicate no fault present.
- The DTC can be cleared using the scan tool clear Info function.

Diagnostic Aids

Normally, an interlock fault will trigger the opening of the auto disconnect, which can only be reset via cycling the ignition. The WAIT light will be illuminated whenever the auto-disconnect is open.

Check for the following conditions:

- If the High Voltage Disconnect is removed with the key ON Battery Pack Control Module DTC 278 and Drive Motor Control Module DTC 070 will be set.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for Battery Pack Control Module DTC(s) first.

DTC 070 - High Voltage Interlock Circuit

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any Battery Pack Control Module DTCs set?	—	Go to other DTCs first	Go to Step 3
3	Is the DTC current?	—	Go to Step 4	Go to Diagnostic Aids
4	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD System Check	—

DTC 071 - Battery Pack Power-up Voltage Low

Circuit Description

The Drive Motor Control Module monitors the battery voltage continuously during operation. The BCA supplies an isolated, scaled (1v = 100v) battery voltage signal to the Drive Motor Control Module. This circuitry is internal to the Power Inverter Module and is checked at start-up to ensure it is within range.

Conditions for Setting the DTC

- Battery voltage read by the Drive Motor Control Module is less then 280 volts at power-up.

Action Taken When the DTC Sets

- DTC is stored in failure records buffer.
- The Drive Motor Control Module illuminates the SERVICE NOW light.
- Propulsion is disabled.

Conditions for Clearing the DTC

- The fault is latched through the current ignition cycle.
- The DTC can be cleared by using a scan tool.

Diagnostic Aids

Check for the following conditions:

- Check for Battery Pack Control Module DTC(s).
- Open in the high voltage supply to the Power Inverter Module.
- Failure in the BCA circuitry.
- Highly discharged or failed batteries, look for Battery Pack Control Module DTC(s).
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks the battery pack voltage as read by the Drive Motor Control Module.
4. This step checks the battery pack voltage as read by the Battery Pack Control Module.
5. This step checks the battery pack voltage as read by the Battery Pack to Power Inverter Module extension tool J 42493.

DTC 071 - Battery Pack Power-up Voltage Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any Battery Pack Control Module DTCs stored?	—	Go to other DTCs first	Go to Step 3
3	Using the scan tool view the Drive Motor Control Module battery assembly voltage. Is the voltage at or below the specified value?	279 V	Go to Step 4	Go to Diagnostic Aids
4	View the Battery Pack Control Module pack voltage. Is the voltage at or below the specified value?	279 V	Go to Step 7	Go to Step 5
5	1. Install the Battery Pack to Power Inverter Module extension tool J 42493 between the battery assembly and the Power Inverter Module. 2. Using a DMM, measure the actual battery assembly voltage. Does the DMM agree with the Battery Pack Control Module within the specified range?	± 20 V	Go to Step 8	Go to Step 6
6	Replace the Battery Assembly. Refer to Battery Assembly Removal and Installation. Is the action complete?	—	Go to Step 9	—

DTC 071 - Battery Pack Power-up Voltage Low (continued)

Step	Action	Value(s)	Yes	No
7	Recharge Battery Pack Assembly to complete. Is the action complete?	—	Go to Step 9	Go to Symptoms *Vehicle Will Not Charge*
8	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation* procedure. Is the repair complete?	—	Go to Step 9	—
9	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 072 - Battery Pack Power-up Voltage High

Circuit Description

The Drive Motor Control Module monitors the battery voltage continuously during operation. The BCA supplies an isolated, scaled (1v = 100v) battery voltage signal to the Drive Motor Control Module. This circuitry is internal to the Power Inverter Module and is checked at start-up to ensure it is within range.

Conditions for Setting the DTC

- Battery voltage read by the Drive Motor Control Module is greater then 420 volts at power-up.

Action Taken When the DTC Sets

- DTC is stored in failure records buffer.
- The Drive Motor Control Module illuminates the SERVICE NOW light.
- Propulsion is disabled.

Conditions for Clearing the DTC

- The DTC can be cleared by using a scan tool.
- The fault is latched through the current ignition cycle.

Diagnostic Aids

Check for the following conditions:

- Check for Battery Pack Control Module DTC(s).
- This DTC can set if the charge paddle is removed during a charge event, batteries full, key ON.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks for Drive Motor Control Module DTC(s) first.
5. This step checks the battery pack voltage as read by the Drive Motor Control Module.
6. This step checks the battery pack voltage as read by the Battery Pack Control Module.
7. This step checks the battery pack voltage as read by the Battery Pack to Power Inverter Module extension tool J 42493.

DTC 072 - Battery Pack Power-up Voltage High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any Battery Pack Control Module DTCs stored?	—	Go to other DTCs first	Go to Step 3
3	Review failure records buffer. Was Drive Motor Control Module DTC 006 set with this DTC?	—	Go to other DTC first.	Go to Step 4
4	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
5	Using the scan tool view the Drive Motor Control Module battery assembly voltage. Is the voltage at or above the specified value?	420 V	Go to Step 6	Go to Diagnostic Aids
6	View the Battery Pack Control Module battery assembly voltage. Is the voltage at or above the specified value?	420 V	Go to Step 8	Go to Step 7
7	1. Install the Battery Pack to Power Inverter Module extension tool J 42493 between the battery assembly and the Power Inverter Module. 2. Using a DMM, measure the actual battery assembly voltage. Does the DMM agree with the Battery Pack Control Module within the specified range?	± 20 V	Go to Step 9	Go to Step 8

DTC 073 Power Inverter Module Bias Control Enable Power-up Check

Circuit Description

The Drive Motor Control Module sends the power supply signal to the BCA to enable or disable power output. During the power-up sequence, this output is tested as follows: With the power supply commanded off, the Drive Motor Control Module sends a small current commanded pulse to the BCA and monitors the phase current feedback input in order to verify that no current was actually generated.

Conditions for Setting the DTC

- The Drive Motor Control Module sees current on the phase current feedback input during BCA enable power-up test.

Action Taken When the DTC Sets

- The Drive Motor Control Module will illuminate the SERVICE SOON light.
- The DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- The fault is latched through the current ignition cycle.
- The DTC can be cleared by using a scan tool.

Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current, this indicates a problem in the Power Inverter Module.

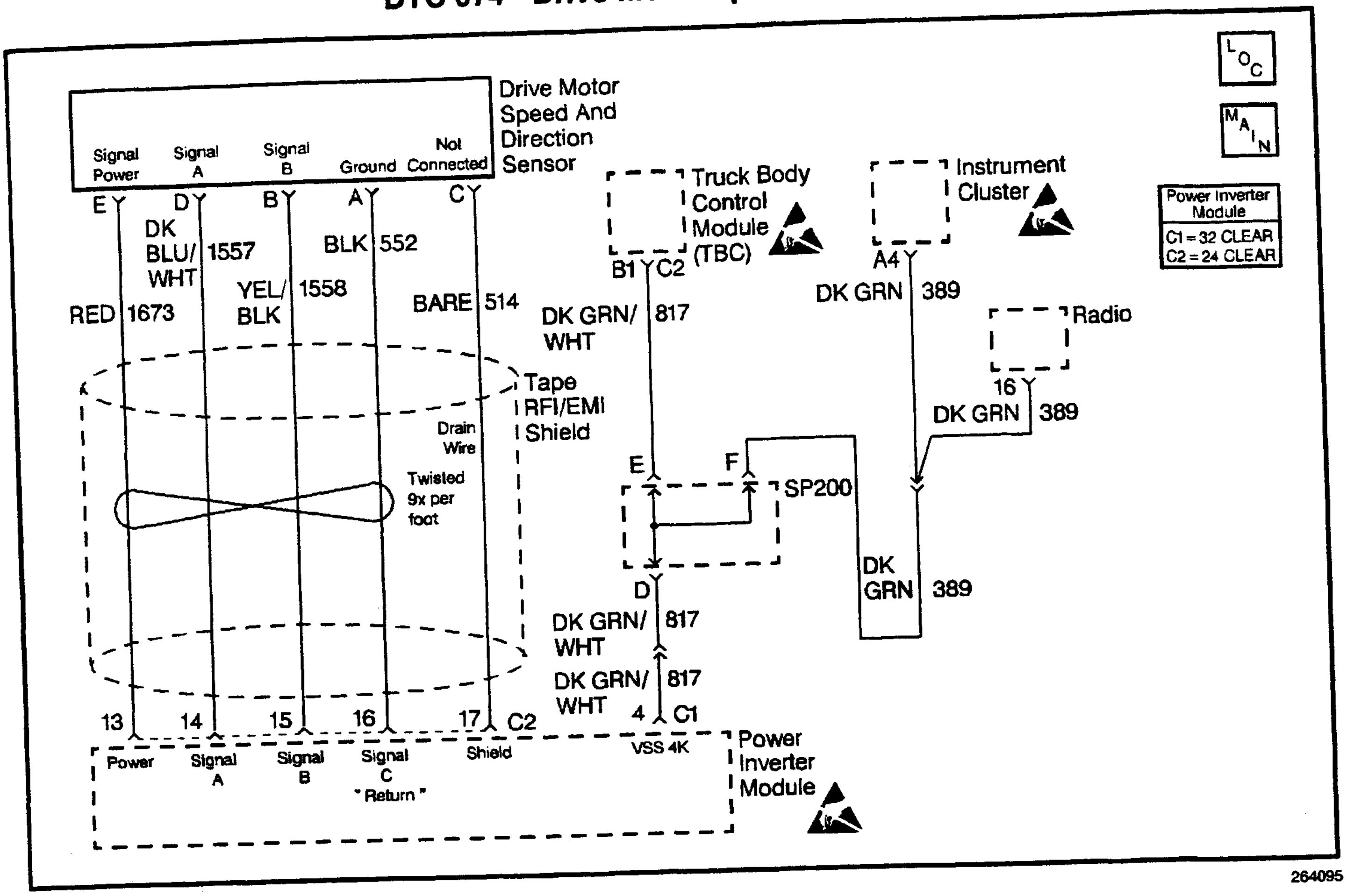
DTC 073 Power Inverter Module Bias Control Enable Power-up Check

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool, check for current DTC 073. Is DTC 073 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Replace the Power Inverter Module . Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 072 - Battery Pack Power-up Voltage High (continued)

Step	Action	Value(s)	Yes	No
8	Battery Pack service is required. Refer to the Battery Pack Internal repair manual.	—	—	—
9	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the repair complete?	—	Go to Step 10	—
10	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 074 - Drive Motor Speed Variation


LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Drive Motor Speed And Direction Sensor
Signal Power
Signal A
Signal B
Ground
Not Connected
E
D
B
A
C
RED 1673
DK BLU/WHT 1557
YEL/BLK 1558
BLK 552
BARE 514
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
Truck Body Control Module (TBC)
B1
C2
DK GRN/WHT 817
Instrument Cluster
A4
DK GRN 389
Radio
16
DK GRN 389
E
F
SP200
D
DK GRN 389
DK GRN/WHT 817
DK GRN/WHT 817
4
C1
13
14
15
16
17
C2
Power
Signal A
Signal B
Signal C "Return"
Shield
VSS 4K
Power Inverter Module
264095

Circuit Description

The Drive Motor Control Module uses and monitors the shaft speed signal for several different functions including vehicle speed, torque control, and cruise control. The Bias Control Assembly generates the Drive Motor Speed and Direction Sensor signal which has 1 pulse for every 1 pulses of the shaft Drive Motor Speed and Direction Sensor signal. The Drive Motor Speed and Direction Sensor is located in the left hand side of the Drive Motor.

Conditions for Setting the DTC

- Excessive periodic variation of the Drive Motor Speed Sensor signal.

Action Taken When the DTC Sets

- The Drive Motor Control Module will illuminate the SERVICE NOW light.
- DTC will be stored in failure records buffer.
- Propulsion is disabled.

Conditions for Clearing the DTC

- The fault is latched through the current ignition cycle.
- The DTC can be cleared by using a scan tool.

Diagnostic Aids

Check for the following conditions:

- If the fault is present the vehicle will shutter during a test drive.
- Check for electromagnetic conductivity.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks the vehicle speed signal with a scan tool.

DTC 074 - Drive Motor Speed Variation

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Clear DTC. 2. Drive the vehicle. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Connect the drive motor Forward/Reverse Signal Generator J 42241. 2. Move the selector switch to the reverse position. 3. Using the scan tool check for reverse vehicle speed. Does the scan tool display vehicle reverse speed at the specified value?	30± 3 mph	Go to Step 7	Go to Step 4
4	Disconnect the PIM 24-way connector and check circuits 1557 and 1558 for open or short. Was the problem found?	—	Go to Step 6	Go to Step 5
5	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation* procedure. Is the repair complete?	—	Go to Step 8	—
6	Repair the open or short to ground in the Power Inverter Module Speed and Direction Sensor Circuit. Is the repair complete?	—	Go to Step 8	—
7	Replace the Drive Motor Speed and Direction Sensor. Refer to *Drive Motor Speed and Direction Sensor Removal and Installation* procedure. Is the repair complete?	—	Go to Step 8	—
8	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 075 - Drive Motor Control Module Reset Occurred

Circuit Description

The Drive Motor Control Module can distinguish the normal power-up condition from an improper reset during operation.

Conditions for Setting the DTC

- The Drive Motor Control Module detects that an abnormal reset has occurred during operation.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.
- The Drive Motor Control Module is restarted.
- The SERVICE SOON Lamp will flash at the time the reset occurred.

Conditions for Clearing the DTC

- The fault is latched through the current ignition cycle.
- The DTC can be cleared by using a scan tool.

Diagnostic Aids

- Check for the following conditions:
- The SERVICE SOON lamp will continually flash if the problem is not corrected by resetting the Drive Motor Control Module.
- This could be caused by an intermittent connection on the 12 volt battery supply to the Drive Motor Control Module.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

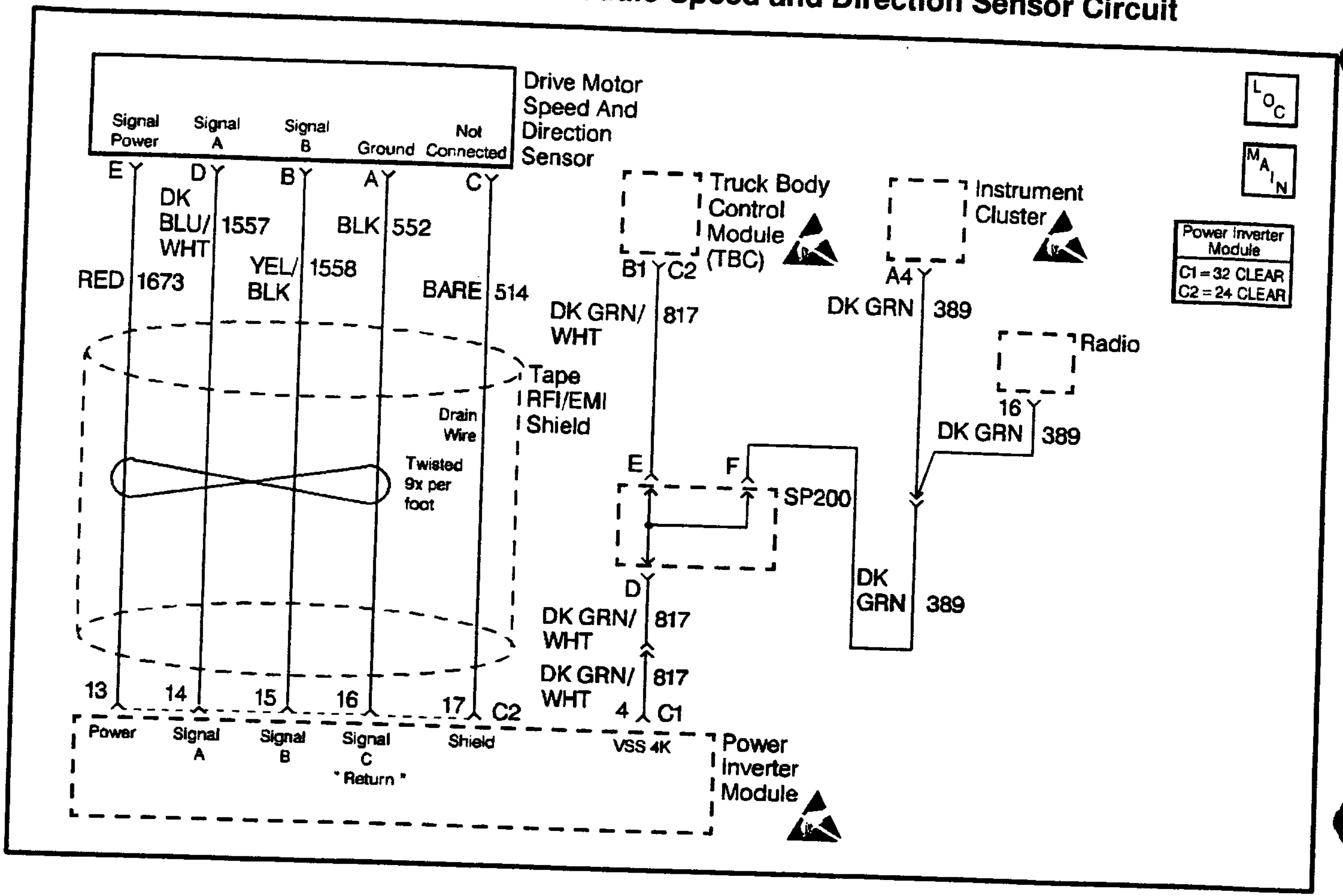
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks If the DTC resets.
3. This checks for a 12 volt supply problem to the Power Inverter Module.

DTC 075 - Drive Motor Control Module Reset Occurred

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Clear DTC(s) and test drive the vehicle. Did DMCM DTC 075 reset?	—	Go to Step 3	Go to Diagnostic Aids
3	Check for a poor connection at the Power Inverter Module 32-way connector terminal 20. Was a poor connection found?	—	Go to Step 4	Go to Step 5
4	Repair the poor connection at the Power Inverter Module 32-way connector. Is the repair complete?	—	Go to Step 6	—
5	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 076 Power Inverter Module Speed and Direction Sensor Circuit



Signal Power
Signal A
Signal B
Ground
Not Connected
Drive Motor Speed And Direction Sensor
E
D
B
A
C
RED 1673
DK BLU/WHT 1557
YEL/BLK 1558
BLK 552
BARE 514
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
Truck Body Control Module (TBC)
B1
C2
DK GRN/WHT 817
Instrument Cluster
A4
DK GRN 389
Radio
16
DK GRN 389
E
F
SP200
D
DK GRN/WHT 817
DK GRN 389
DK GRN/WHT 817
13
14
15
16
17
C2
4
C1
Power
Signal A
Signal B
Signal C "Return"
Shield
VSS 4K
Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
264095

Circuit Description

The BCA receives two separate square wave signals from the speed sensor at 128 pulses per revolution. They are channel A and B. The Bias Control Assembly contains on-board diagnostic circuitry which can detect several types of faults which are classified as critical or non-critical. There are multiple critical faults defined, but only one non-critical fault defined by the BCA (speed and direction sensor fault). When the Bias Control Assembly detects a critical fault, it asserts the critical fault line to the Drive Motor Control Module. The Bias Control Assembly also contains an on-board fault register which contains additional fault information. This fault register is read serially by the Drive Motor Control Module after a critical or non-critical fault.

Conditions for Setting the DTC

- There are six transitions on one channel before you see any transitions on the other.
- BCA non-critical fault input is high for 30 milliseconds.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE NOW light.
- DTC will be stored in failure records buffer.
- Propulsion is disabled.
- Immediately after receiving a non-critical fault, the Drive Motor Control Module reads the BCA fault register and sets additional DTCs based on the information it receives. (See DTC 043). Once a non-critical fault has been detected, it is latched by the Drive Motor Control Module for the duration of the ignition cycle.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- DMCM DTC 043 will always set in conjunction with DTC 076.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

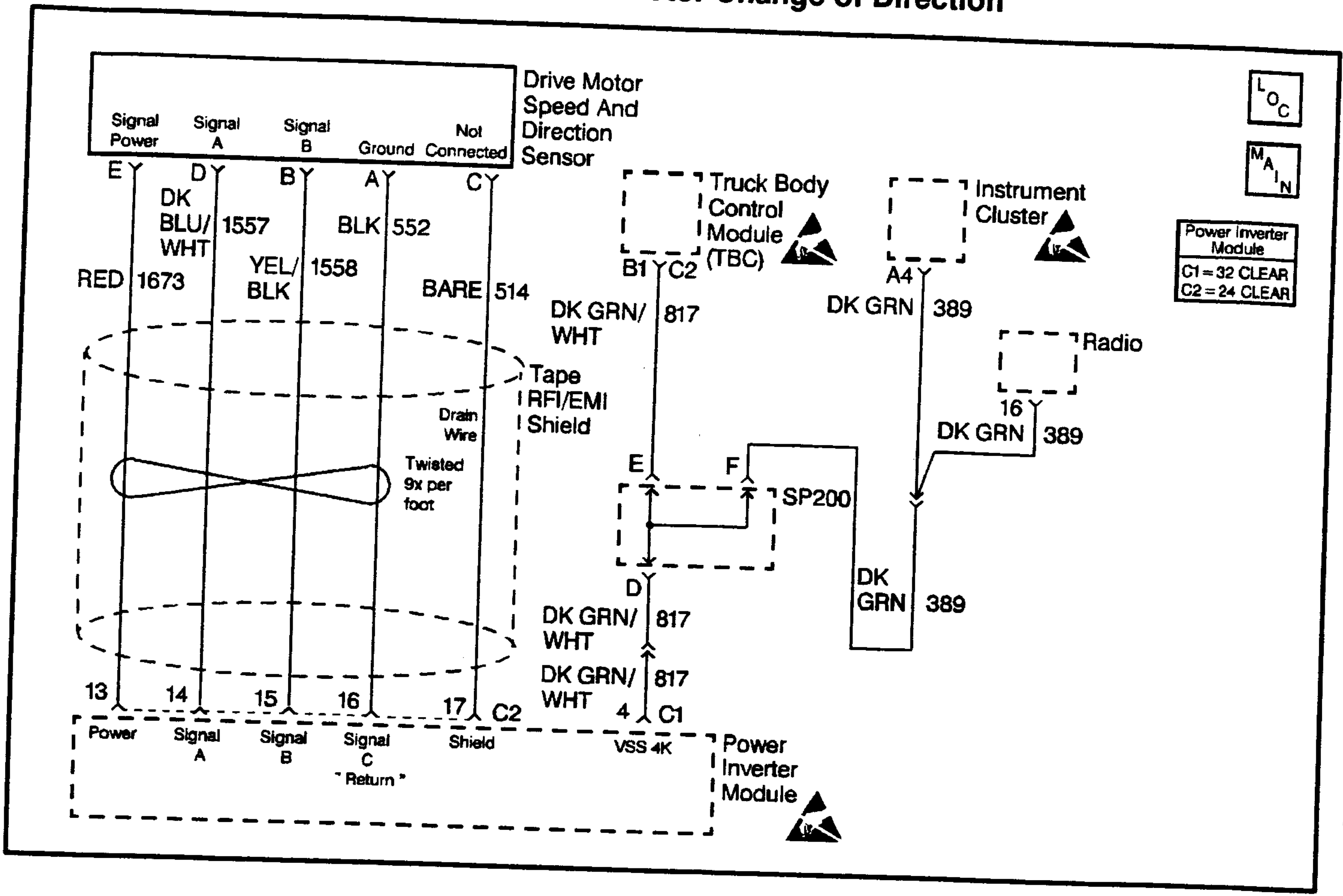
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks vehicle speed with a scan tool.

DTC 076 Power Inverter Module Speed and Direction Sensor Circuit

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Clear the DTC. 2. Attempt to drive the vehicle. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Connect the Forward/reverse signal generator J 42241 and send a reverse signal to the Power Inverter Module. 2. Using the scan tool check for reverse vehicle speed. Does the scan tool display vehicle speed at the specified value? Notice: After switching signal generator J 42241 back to OFF from the REVERSE position, Drive Motor Control Module DTCs 043, 076, and 080 will be set. This is a normal result during this test.	30 ± 3 mph	Go to Step 5	Go to Step 4
4	Disconnect the Power Inverter Module 24-way connector and check circuits 1557 and 1558 for open or short to ground. Was the problem found?	—	Go to Step 7	Go to Step 6
5	Check the Drive motor speed and direction sensor harness connector for poor connection. Was a poor connection found?	—	Go to Step 7	Go to Step 8
6	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation* procedure. Is the repair complete?	—	Go to Step 9	—
7	Repair the open or short to ground in the Drive Motor Power Inverter Module Speed and Direction Sensor Circuit. Is the repair complete?	—	Go to Step 9	—
8	Replace the Drive Motor Speed and Direction Sensor. Refer to *Drive Motor Speed and Direction Sensor Removal and Installation* procedure. Is the repair complete?	—	Go to Step 9	—
9	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 079 - Drive Motor Change of Direction


Drive Motor Speed And Direction Sensor
Signal Power
Signal A
Signal B
Ground
Not Connected
E
D
B
A
C
DK BLU/ WHT 1557
RED 1673
YEL/ BLK 1558
BLK 552
BARE 514
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
Truck Body Control Module (TBC)
B1
C2
DK GRN/ WHT 817
Instrument Cluster
A4
DK GRN 389
Radio
16
DK GRN 389
SP200
E
F
D
DK GRN 389
DK GRN/ WHT 817
DK GRN/ WHT 817
13
14
15
16
17
C2
4
C1
Power
Signal A
Signal B
Signal C "Return"
Shield
VSS 4K
Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
264095

Circuit Description

The BCA receives two separate square wave signals from the Drive Motor Speed and Direction Sensor at 128 PWM/revolution. They are channel A and B. The direction is determined by which signal is leading and the voltage level. If signal A is leading signal B , then the drive motor is turning in a clockwise direction and the vehicle is moving in a forward direction. Conversely, if the signal B is leading signal A then the drive motor is turning in the counter clockwise rotation or the vehicle is moving in the reverse direction. The BCA contains on-board diagnostic circuitry which can detect several types of faults which are classified as critical or no-critical. When the BCA detects a critical fault, it asserts the non-critical fault line to the Drive Motor Control Module. The BCA also contains an on-board fault register which contains additional fault information. This fault register is read serially by the Drive Motor Control Module after a critical or non-critical fault.

Conditions for Setting the DTC

- Drive motor shaft speed greater than 2000 RPM (= vehicle speed of 12 Mph).
- Any change in drive motor shaft direction for more than 1 second.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE NOW light.
- DTC will be stored in failure records buffer.
- Propulsion is disabled.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle.

Diagnostic Aids

Check for the following conditions:

- Check for electromagnetic conductivity.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

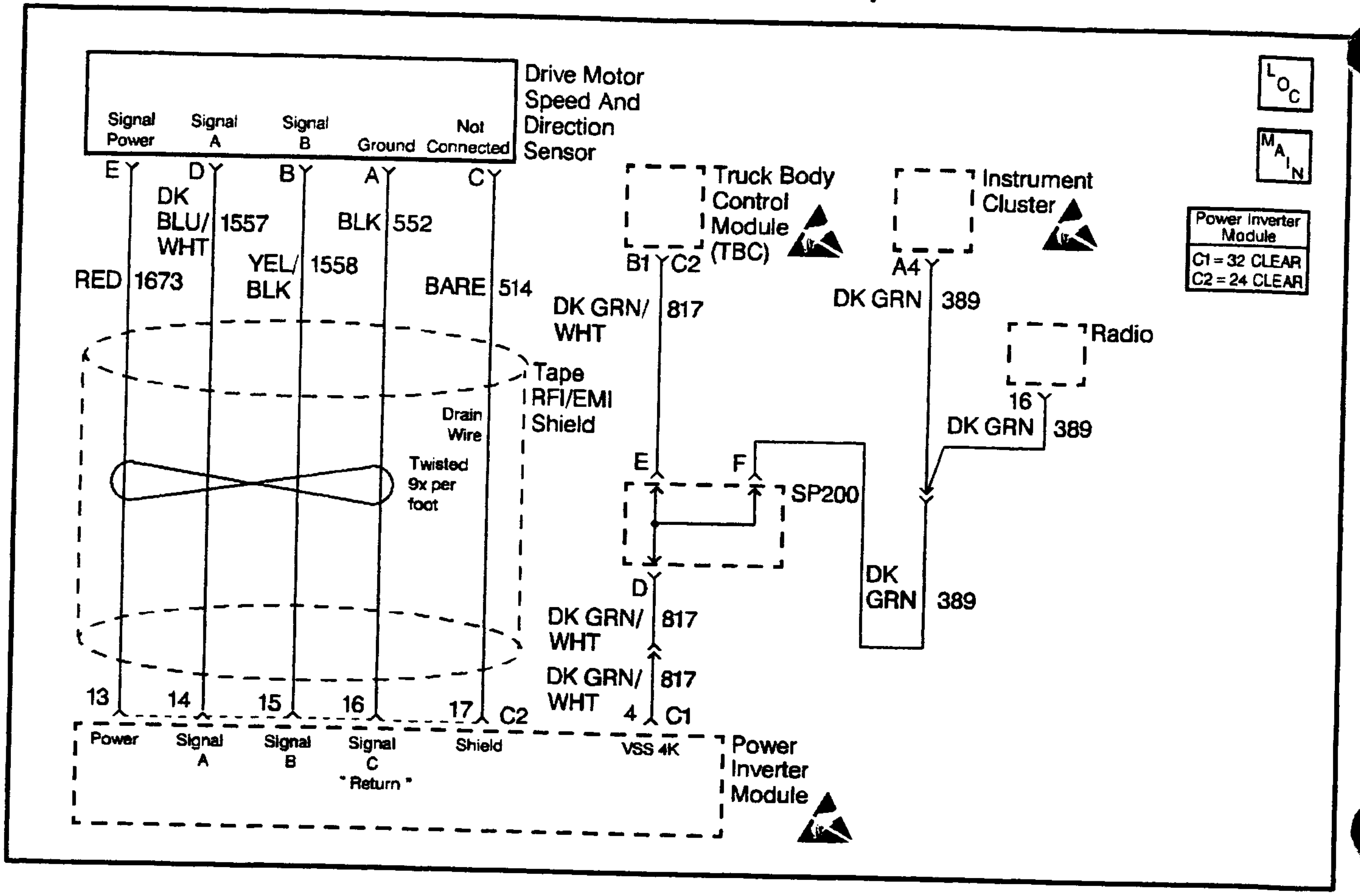
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks the function of the Drive Motor Speed and Direction Sensor circuit.

DTC 079 - Drive Motor Change of Direction

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Connect the drive motor Forward/Reverse Signal Generator J 42241. 2. Move the selector switch to the reverse position. 3. Using the scan tool check for reverse vehicle speed. Does the scan tool display vehicle reverse speed at the specified value?	30± 3 mph	Go to Step 6	Go to Step 3
3	Disconnect the Power Inverter Module 24-way connector and check signal A and signal B circuits for an open or a short. Was the problem found?	—	Go to Step 5	Go to Step 4
4	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation* procedure. Is the repair complete?	—	Go to Step 7	—
5	Repair the open or short to ground in the Drive Motor Power Inverter Module Speed and Direction Sensor Circuit. Refer to *Electrical Diagnosis.* Is the repair complete?	—	Go to Step 7	—
6	Replace the Drive Motor Speed and Direction Sensor. Refer to *Drive Motor Speed and Direction Sensor Removal and Installation* procedure. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 080 - Drive Motor Zero Speed



Signal Power
Signal A
Signal B
Ground
Not Connected
Drive Motor Speed And Direction Sensor
E
D
B
A
C
DK BLU/WHT 1557
BLK 552
RED 1673
YEL/BLK 1558
BARE 514
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
Truck Body Control Module (TBC)
B1
C2
DK GRN/WHT 817
Instrument Cluster
A4
DK GRN 389
Radio
16
DK GRN 389
E
F
SP200
D
DK GRN 389
DK GRN/WHT 817
DK GRN/WHT 817
13
14
15
16
17
C2
4
C1
Power
Signal A
Signal B
Signal C "Return"
Shield
VSS 4K
Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
264095

Circuit Description

The BCA receives two separate square wave signals from the Drive Motor Speed and Direction Sensor at 128 PWM/revolution. They are channel A and B. The direction is determined by which signal is leading and the voltage level. If signal A is leading signal B, then the drive motor is turning in a clockwise direction and the vehicle is moving in a forward direction. Conversely, if the signal B is leading signal A then the drive motor is turning in the counter clockwise rotation or the vehicle is moving in the reverse direction. The BCA contains on-board diagnostic circuitry which can detect several types of faults which are classified as critical or no-critical. When the BCA detects a critical fault, it asserts the non-critical fault line to the Drive Motor Control Module. The BCA also contains an on-board fault register which contains additional fault information. This fault register is read serially by the Drive Motor Control Module after a critical or non-critical fault.

Conditions for Setting the DTC

- Drive motor shaft speed decreases more then 1000 RPM within 7.8 ms then drops to Zero (0).

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE NOW light.
- DTC will be stored in failure records buffer.
- Propulsion is disabled.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function one ignition cycle after the fault is no longer present.

Diagnostic Aids

Check for the following conditions:

- Check for electromagnetic conductivity.
- Check for DTC 043 and 076 also set.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

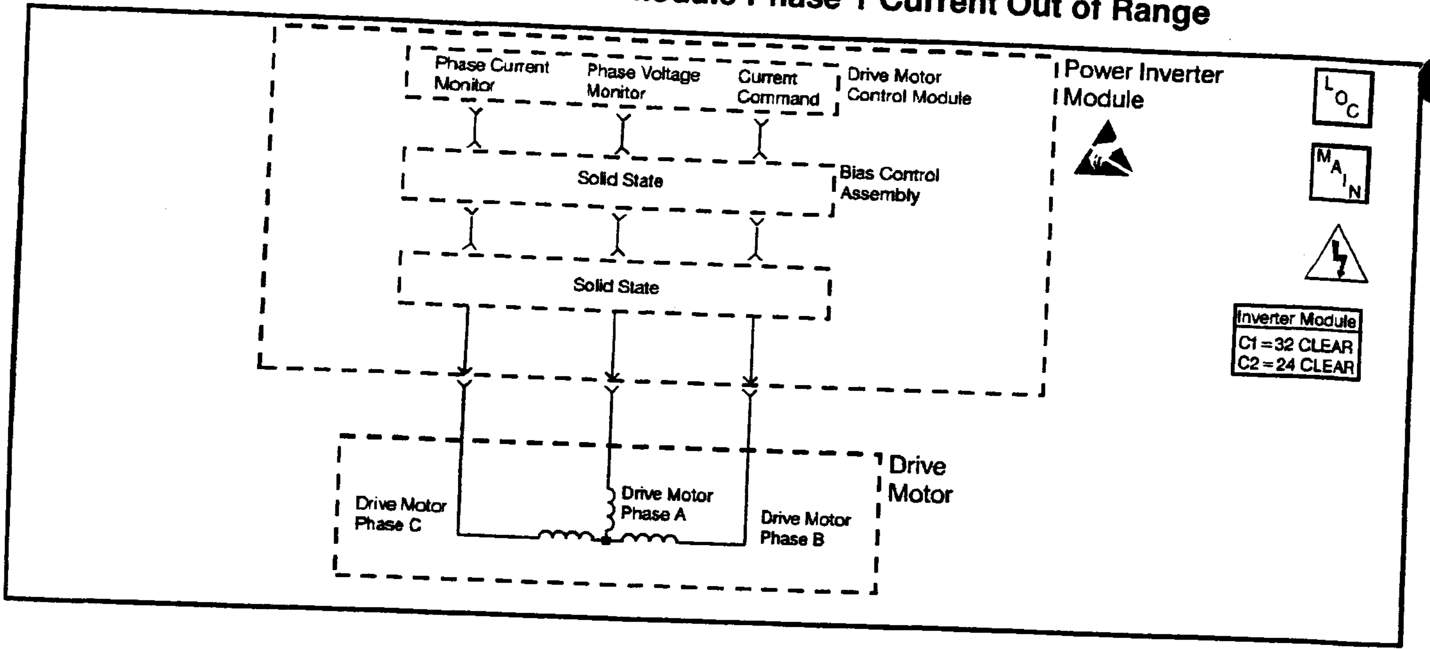
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for power to the Drive Motor Speed and Direction Sensor.
3. Checks for a good ground from the Drive Motor Speed and Direction Sensor to the Power Inverter Module.
4. Checks the function of the Drive Motor Speed and Direction Sensor circuit.

DTC 080 - Drive Motor Zero Speed

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Remove the Drive Motor Speed and Direction Sensor connector. 2. Using a DMM, check circuit 1673 for voltage. Is the voltage at or above the specified value?	12 V	Go to Step 3	Go to Step 7
3	Using a test light connected to 12 volts, probe ground circuit 552 at the Drive Motor Speed and Direction Sensor harness connector. Did the test light turn ON?	—	Go to Step 4	Go to Step 7
4	1. Connect the drive motor Forward/Reverse Signal Generator J 42241. 2. Move the selector switch to the reverse position. 3. Using the scan tool check for reverse vehicle speed. Does the scan tool display vehicle speed at the specified value?	30±3 mph	Go to Step 8	Go to Step 5
5	Disconnect the Power Inverter Module 24-way connector and check signal A and signal B circuits for an open or a short to ground. Was the problem found?	—	Go to Step 7	Go to Step 6
6	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation* procedure. Is the repair complete?	—	Go to Step 9	—
7	Repair the open or short to ground in the Drive Motor Power Inverter Module Speed and Direction Sensor Circuit. Refer to *Electrical Diagnosis.* Is the repair complete?	—	Go to Step 9	—
8	Replace the Drive Motor Speed and Direction Sensor. Refer to *Drive Motor Speed and Direction Sensor Removal and Installation* procedure. Is the action complete?	—	Go to Step 9	—
9	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 081 Power Inverter Module Phase 1 Current Out of Range


Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Power Inverter Module
Solid State
Bias Control Assembly
Solid State
Drive Motor
Drive Motor Phase C
Drive Motor Phase A
Drive Motor Phase B
LOC
MAIN
Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR

125881

Circuit Description

The BCA has a discrete circuit that monitors the operation of the IGBTs. The Drive Motor Control Module looks at the BCA register and if a failure is set in BCA, the Drive Motor Control Module reports by setting a DTC.

Conditions for Setting the DTC

- A problem is detected with the phase 1 IGBT.

Action Taken When the DTC Sets

- The Drive Motor Control Module turns ON the SERVICE NOW light.
- The DTC will be stored in failure records.
- Propulsion is disabled.

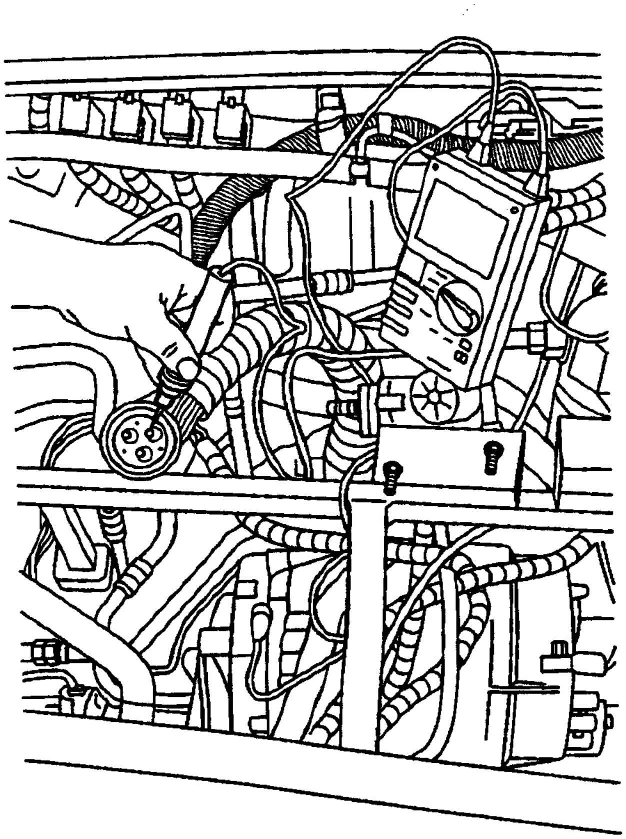
Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Insulation Test



179015

Test Description

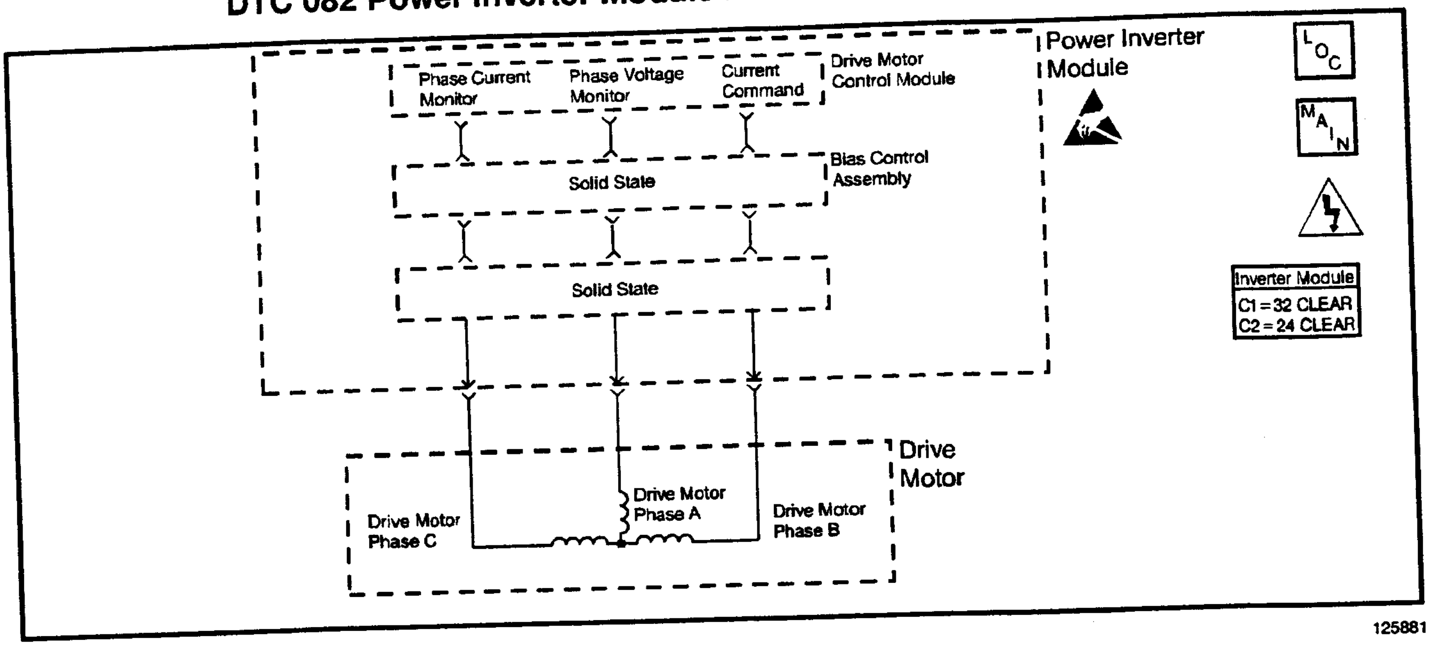
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current, this indicates a problem in the Power Inverter Module.
3. This checks the phase windings for a leak to ground.
4. This check the integrity of the phase windings.

DTC 081 Power Inverter Module Phase 1 Current Out of Range

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool, check for current DTC 081. Is DTC 081 current?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled.*** 1. Perform the high voltage disable procedure. 2. Remove the Power Inverter Module to drive motor cannon connector at the Power Inverter Module. 3. Using the Digital Insulation Tester J 42502, Clip the black lead to the drive motor housing. 4. Switch the Insulation tester J 42502 to the 1000 volts position. 5. Check each phase for an short condition buy turning the tester ON and probing each pin on the drive motor one at a time. Did each drive motor winding phase read equal to or greater then the specified resistance?	5M ohms	Go to Step 4	Go to Step 5
4	1. Place the Digital Insulation Tester J 42502 in the continuity position. 2. Place the ground probe on phase 1 of the drive motor winding and touch the positive probe end to phases 2 and 3, allow the reading to stabilize and record readings. 3. Place the ground probe on phase 2 and touch phase 3 with the positive probe, allow the reading to stabilize and record reading. Were the resistance readings within the specified range?	1.8 - 2.2 ohms	Go to Step 6	Go to Step 5
5	Replace the drive motor. Refer to *Drive Motor and Front Axles replacement.* Is the action complete?	—	Go to Step 7	—
6	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 082 Power Inverter Module Phase 2 Current Out of Range


Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Power Inverter Module
Solid State
Bias Control Assembly
Solid State
Drive Motor
Drive Motor Phase A
Drive Motor Phase C
Drive Motor Phase B
LOC
MAIN
Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR

125881

Circuit Description

The BCA monitors the saturation voltage on the IGBT. The Drive Motor Control Module looks at the BCA register and if a failure is set in BCA, the Drive Motor Control Module reports by setting a DTC.

Conditions for Setting the DTC

- A problem is detected with the phase 2 IGBT.

Action Taken When the DTC Sets

- The Drive Motor Control Module turns ON the SERVICE NOW light.
- The DTC will be stored in failure records.
- Propulsion is disabled.

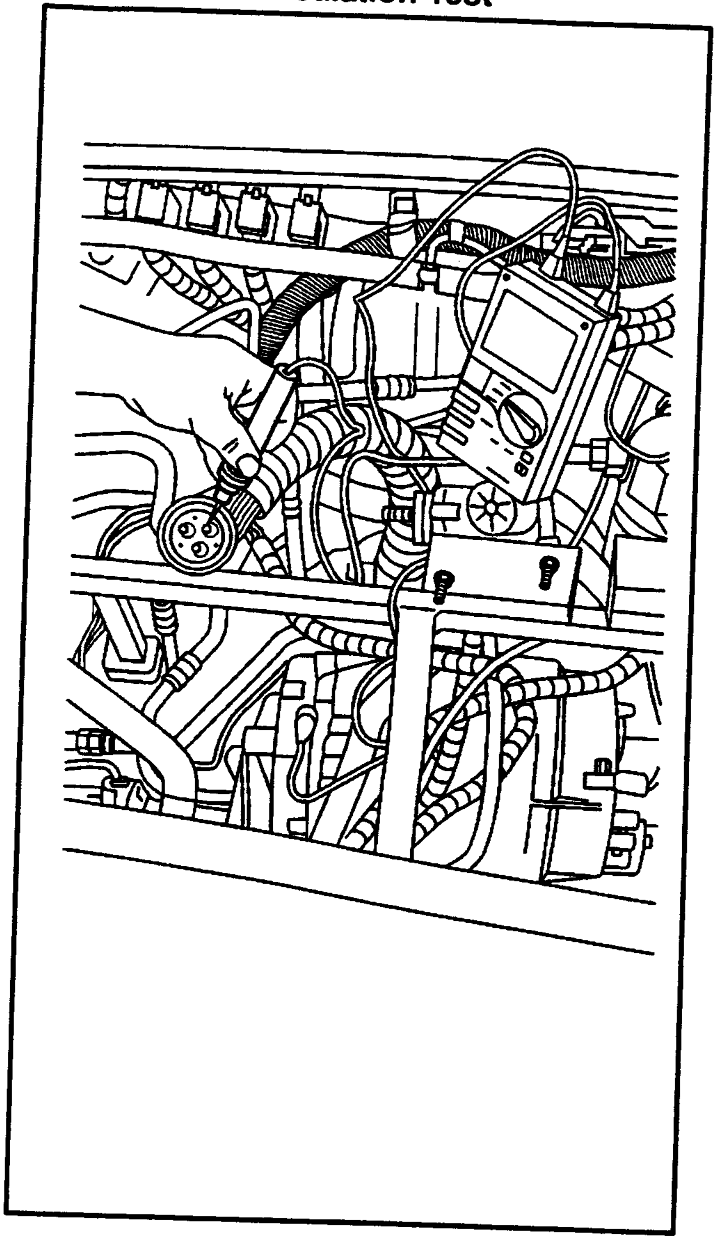
Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Insulation Test



179015

Test Description

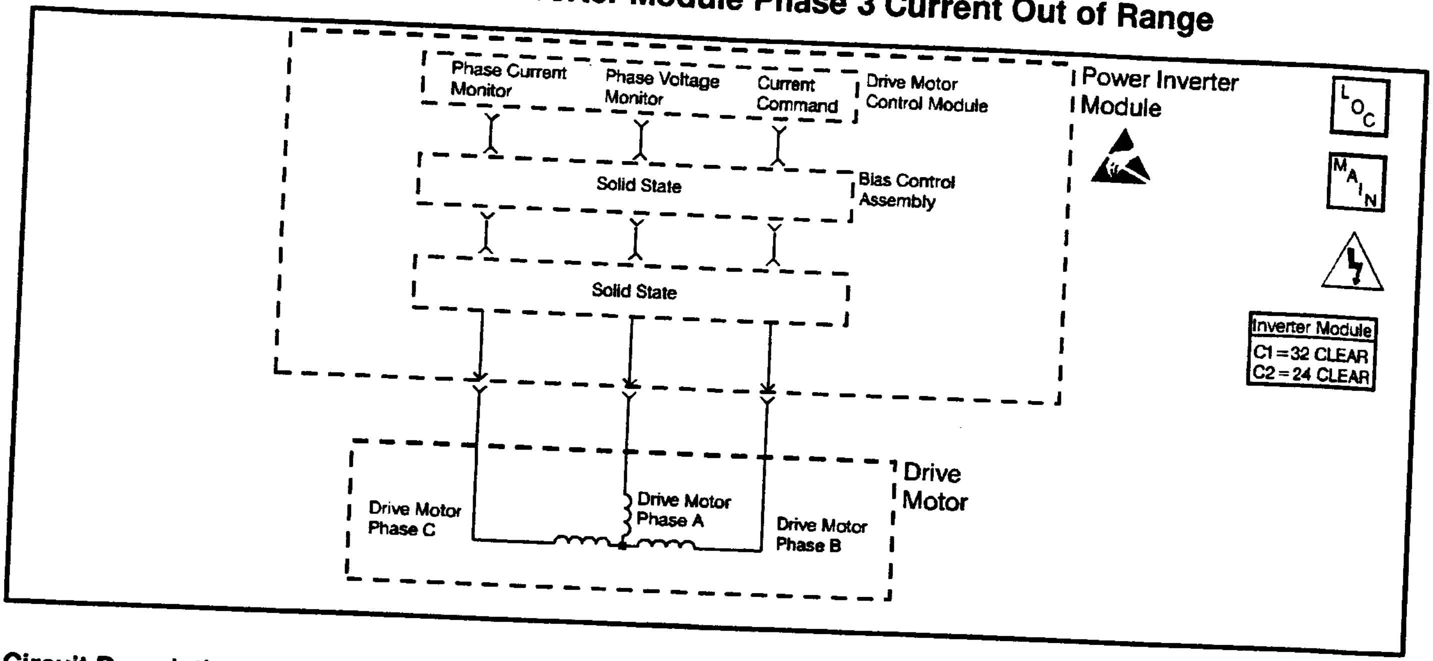
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current, this indicates a problem in the Power Inverter Module.
3. This checks the phase windings for a leak to ground.
4. This check the integrity of the phase windings.

DTC 082 Power Inverter Module Phase 2 Current Out of Range

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool, check for current DTC 082. Is DTC 082 current?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled*** 1. Perform the high voltage disable procedure. 2. Remove the Power Inverter Module to drive motor cannon connector at the Power Inverter Module. 3. Using the Digital Insulation Tester J 42502, Clip the black lead to the drive motor housing. 4. Switch the Insulation tester J 42502 to the 1000 volts position. 5. Check each phase for an short condition buy turning the tester ON and probing each pin on the drive motor one at a time. Did each drive motor winding phase read equal to or greater then the specified resistance?	5M ohms	Go to Step 4	Go to Step 5
4	1. Place the Digital Insulation Tester J 42502 in the continuity position. 2. Place the ground probe on phase 1 of the drive motor winding and touch the positive probe end to phases 2 and 3, allow the reading to stabilize and record readings. 3. Place the ground probe on phase 2 and touch phase 3 with the positive probe, allow the reading to stabilize and record reading. Were the resistance readings within the specified range?	1.8 - 2.2 ohms	Go to Step 6	Go to Step 5
5	Replace the drive motor. Refer to *Drive Motor and Front Axles replacement.* Is the action complete?	—	Go to Step 7	—
6	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 083 Power Inverter Module Phase 3 Current Out of Range


Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Power Inverter Module
Solid State
Bias Control Assembly
Solid State
LOC
MAIN
Inverter Module
C1=32 CLEAR
C2=24 CLEAR
Drive Motor
Drive Motor Phase C
Drive Motor Phase A
Drive Motor Phase B

125881

Circuit Description

The BCA monitors an analog signal that represents the high voltage AC current as measured at the Drive Motor output. This measurement is monitored for each motor phase current. This signal provides feedback to the BCA that the command output equals the actual output. The Drive Motor Control Module looks at the BCA register and if a failure is set in BCA, the Drive Motor Control Module reports by setting a DTC.

Conditions for Setting the DTC

- Phase 3 current feedback does not match the actual output.

Action Taken When the DTC Sets

- The Drive Motor Control Module turns ON the SERVICE NOW light.
- The DTC will be stored in failure records.
- Propulsion is disabled.

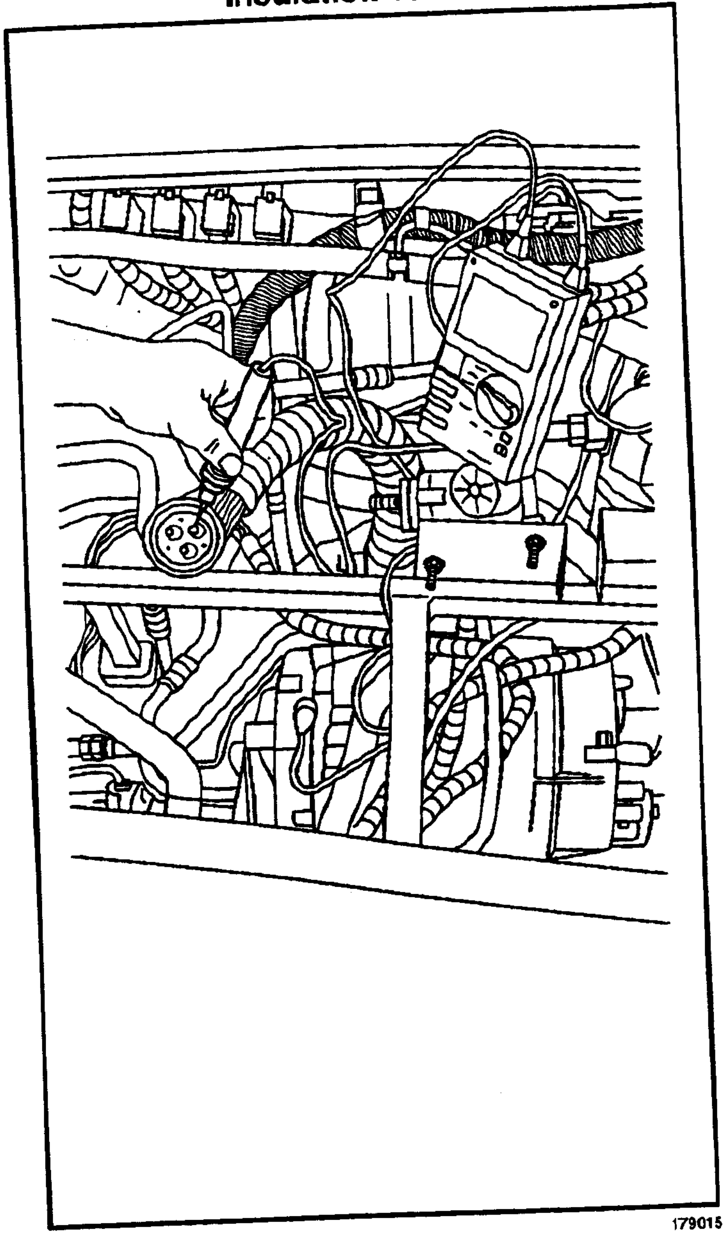
Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Insulation Test



Test Description

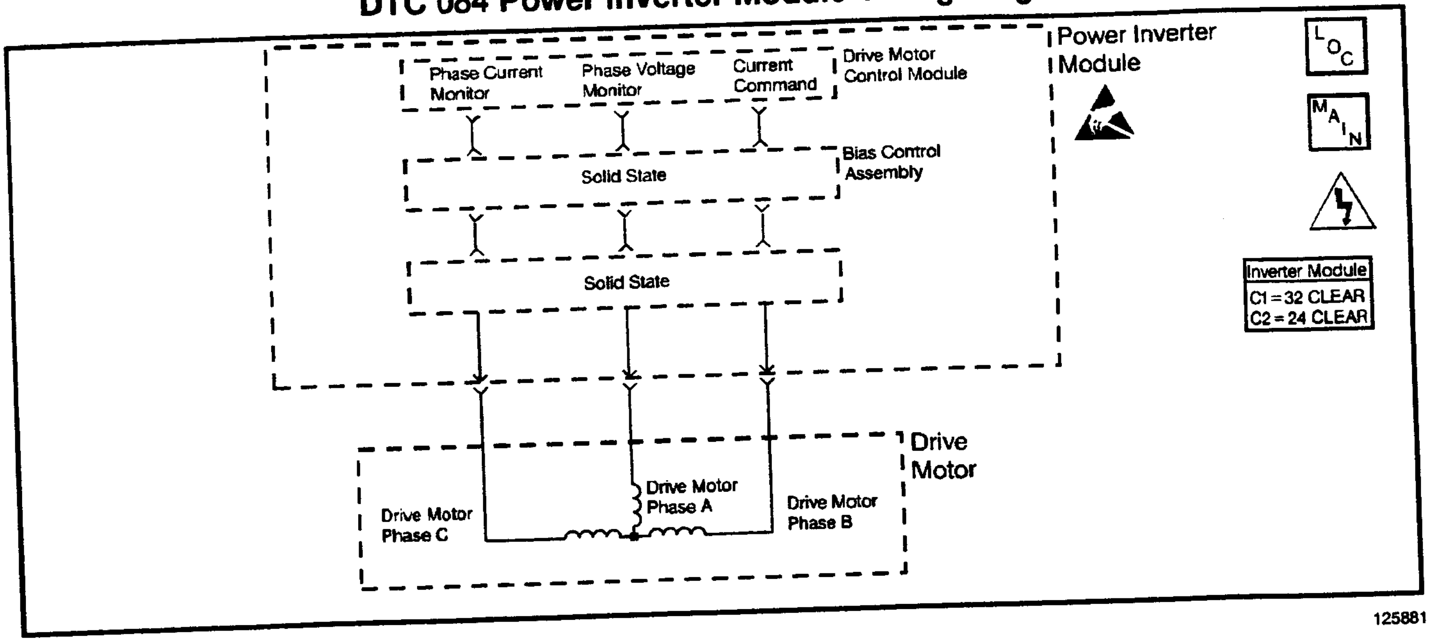
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current, this indicates a problem in the Power Inverter Module.
3. This checks the phase windings for a leak to ground.
4. This check the integrity of the phase windings.

DTC 083 Power Inverter Module Phase 3 Current Out of Range

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool, check for current DTC 083. Is DTC 083 current?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled*** 1. Perform the high voltage disable procedure. 2. Remove the Power Inverter Module to drive motor cannon connector at the Power Inverter Module. 3. Using the Digital Insulation Tester J 42502, Clip the black lead to the drive motor housing. 4. Switch the Insulation tester J 42502 to the 1000 volts position. 5. Check each phase for an short condition buy turning the tester ON and probing each pin on the drive motor one at a time. Did each drive motor winding phase read equal to or greater then the specified resistance?	5M ohms	Go to Step 4	Go to Step 5
4	1. Place the Digital Insulation Tester J 42502 in the continuity position. 2. Place the ground probe on phase 1 of the drive motor winding and touch the positive probe end to phases 2 and 3, allow the reading to stabilize and record readings. 3. Place the ground probe on phase 2 and touch phase 3 with the positive probe, allow the reading to stabilize and record reading. Were the resistance readings within the specified range?	1.8 - 2.2 ohms	Go to Step 6	Go to Step 5
5	Replace the drive motor. Refer to *Drive Motor and Front Axles replacement.* Is the action complete?	—	Go to Step 7	—
6	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 084 Power Inverter Module Voltage High


Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Power Inverter Module
Bias Control Assembly
Solid State
Solid State
Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Drive Motor
Drive Motor Phase A
Drive Motor Phase B
Drive Motor Phase C
L O C
M A I N

125881

Circuit Description

The BCA receives high voltage from the battery assembly to convert to drive motor power. The incoming voltage is monitored by the BCA to ensure it does not exceed its limits.

Conditions for Setting the DTC

- The BCA detects a DC bus over voltage between 420 and 460.

Action Taken When the DTC Sets

- The DTC will be stored in failure records buffer.
- Propulsion is disabled.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Check for Battery Pack Control Module DTC(s).

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for Battery Pack Control Module DTC(s) first.

DTC 084 Power Inverter Module Voltage High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool, check for Battery Pack Control Module DTC(s). Are any Battery Pack Control Module DTCs set?	—	Go to other DTCs first	Go to Step 3
3	Using a scan tool, check for current Drive Motor Control Module DTC 084. Is DTC 084 current?	—	Go to Step 4	Go to Diagnostic Aids
4	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 085 Power Inverter Module Voltage Low

Circuit Description

The BCA receives high voltage from the battery assembly to convert to drive motor power. The incoming voltage is used to create a floating power supply called the bias supply. The bias supply is used to turn on and off the positive and negative IGBTs. The bias supply is ± 15 volts depending which IGBT is turning on.

Conditions for Setting the DTC

- The BCA reads bias supply voltage less then a calibrated value.

Action Taken When the DTC Sets

- The DTC will be stored in failure records buffer.
- Propulsion is disabled.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- A very low voltage condition from the battery pack may cause this DTC to set. Always check for Battery Pack Control Module DTC(s) before replacing the Power Inverter Module.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

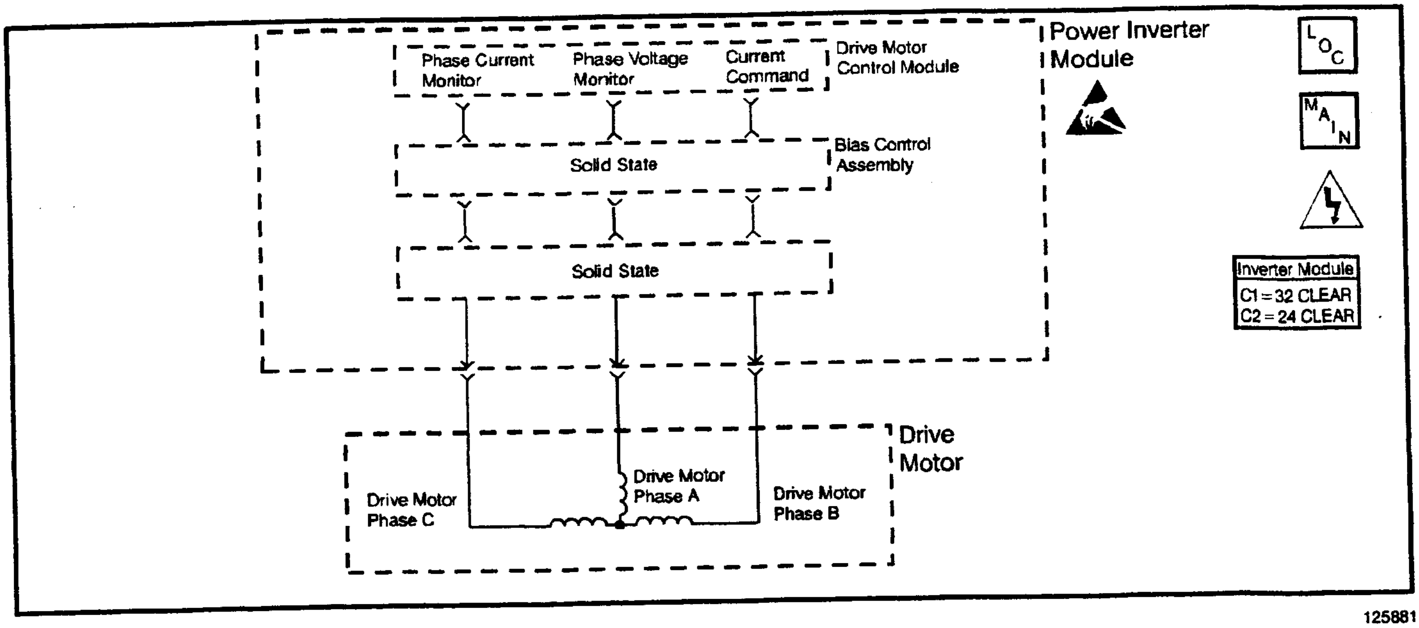
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for Battery Pack Control Module DTC(s) first.

DTC 085 Power Inverter Module Voltage Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any Battery Pack Control Module DTCs set?	—	Go to other DTCs first	Go to Step 3
3	Is the fault present?	—	Go to Step 4	Go to Diagnostic Aids
4	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 087 Power Inverter Module Bias Control System


Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Power Inverter Module
Bias Control Assembly
Solid State
Solid State
Drive Motor
Drive Motor Phase C
Drive Motor Phase A
Drive Motor Phase B
LOC
MAIN
Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR

125881

Circuit Description

The Drive Motor Control Module sends to the BCA slip frequency and direction. It is passed by two signals Slip A and Slip B. When Slip A signal is leading Slip B signal this indicates the drive motor direction as forward. If Slip A lags Slip B this indicates the drive motor direction as reverse. The Drive Motor Control Module slip frequency is multiplied by 128 and used for the desired drive motor slip.

Conditions for Setting the DTC

- The BCA indicates a slip problem.

Action Taken When the DTC Sets

- The DTC will be stored in failure records buffer.
- Propulsion will be disabled.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle.

Diagnostic Aids

Check for the following conditions:

- Check for Drive Motor Control Module DTC 044.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

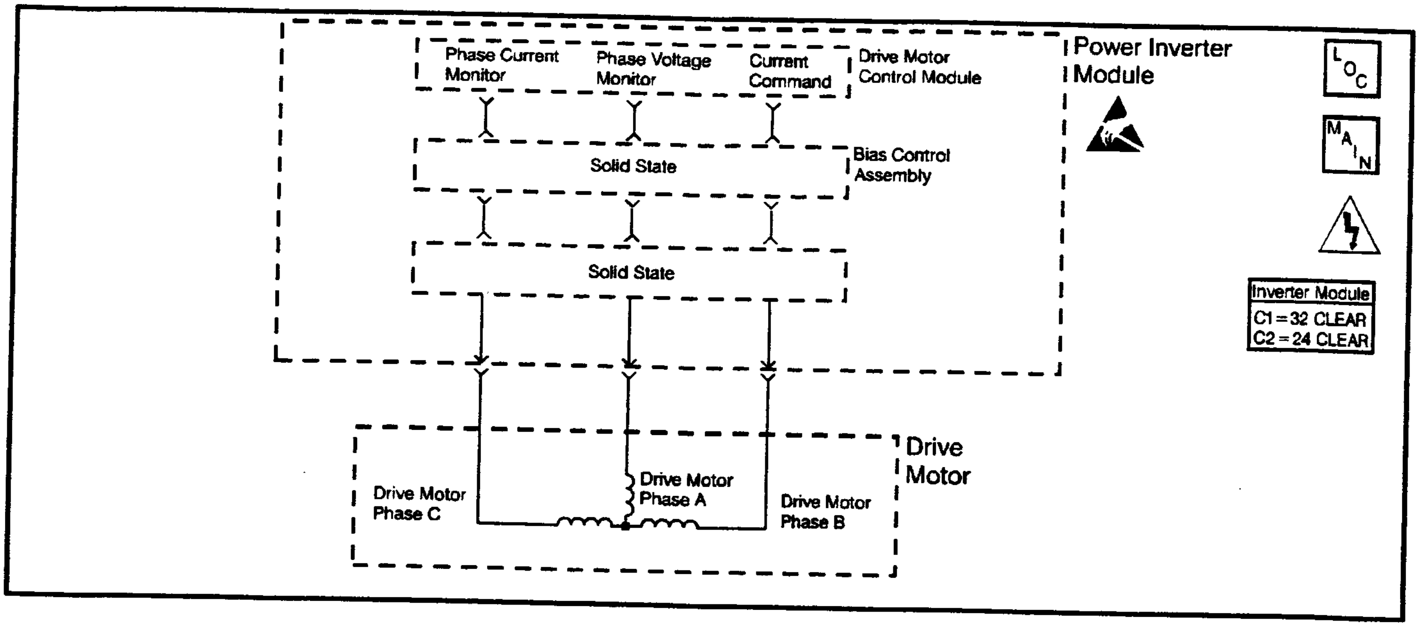
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current, this indicates a problem in the Power Inverter Module.

DTC 087 Power Inverter Module Bias Control System

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool, check for current DTC 087. Is DTC 087 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 088 Power Inverter Module Bias Control Current Command


Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Solid State
Bias Control Assembly
Solid State
Power Inverter Module
LOC
MAIN
Inverter Module
C1=32 CLEAR
C2=24 CLEAR
Drive Motor Phase C
Drive Motor Phase A
Drive Motor Phase B
Drive Motor

125881

Circuit Description

The Drive motor Control Module receives inputs to calculate the required current command. The current command is sent to the bias control assembly as a pulse width modulated signal and this signal is used for drive motor operation. The bias control assembly receives a feed back of the signal to ensure the proper signal was received.

Conditions for Setting the DTC

- The BCA indicates a current command problem.

Action Taken When the DTC Sets

- The DTC will be stored in failure records buffer.
- Propulsion will be disabled.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle.

Diagnostic Aids

Check for the following conditions:

- Check for Drive Motor Control Module DTC 044.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

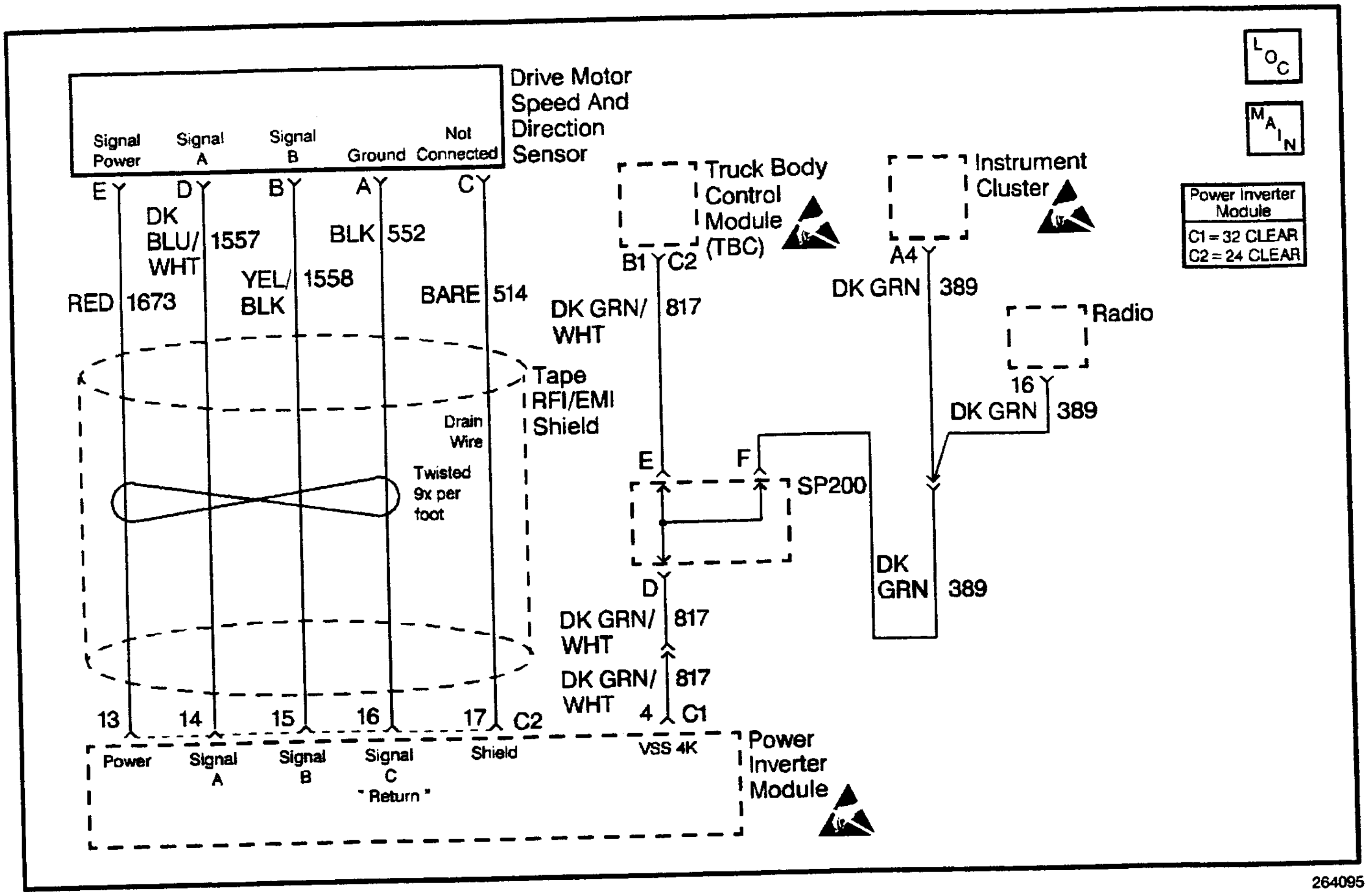
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current, this indicates a problem in the Power Inverter Module.

DTC 088 Power Inverter Module Bias Control Current Command

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool, check for current DTC 088. Is DTC 088 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 089 - Forward Control Circuit Failed Power-up



Drive Motor Speed And Direction Sensor
Signal Power
Signal A
Signal B
Ground
Not Connected
E
D
B
A
C
DK BLU/ WHT
1557
BLK
552
RED
1673
YEL/ BLK
1558
BARE
514
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
Truck Body Control Module (TBC)
B1
C2
DK GRN/ WHT
817
Instrument Cluster
A4
DK GRN
389
Radio
16
DK GRN
389
E
F
SP200
D
DK GRN/ WHT
817
DK GRN
389
DK GRN/ WHT
817
4
C1
13
14
15
16
17
C2
Power
Signal A
Signal B
Signal C "Return"
Shield
VSS 4K
Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR

264095

Circuit Description

command a current and look for feedback it should be in range.

The Drive Motor Control Module sends to the BCA slip frequency and direction. It is passed by two signals Slip A and Slip B. When Slip A signal is leading Slip B signal this indicates the drive motor direction as forward. If Slip A lags Slip B this indicates the drive motor direction as reverse. The Drive Motor Control Module slip frequency is multiplied by 128 and used for the desired drive motor slip.

Conditions for Setting the DTC

- The BCA detects an invalid slip signal at power-up.

Action Taken When the DTC Sets

- The DTC will be stored in failure records buffer.
- Propulsion will be disabled.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle.

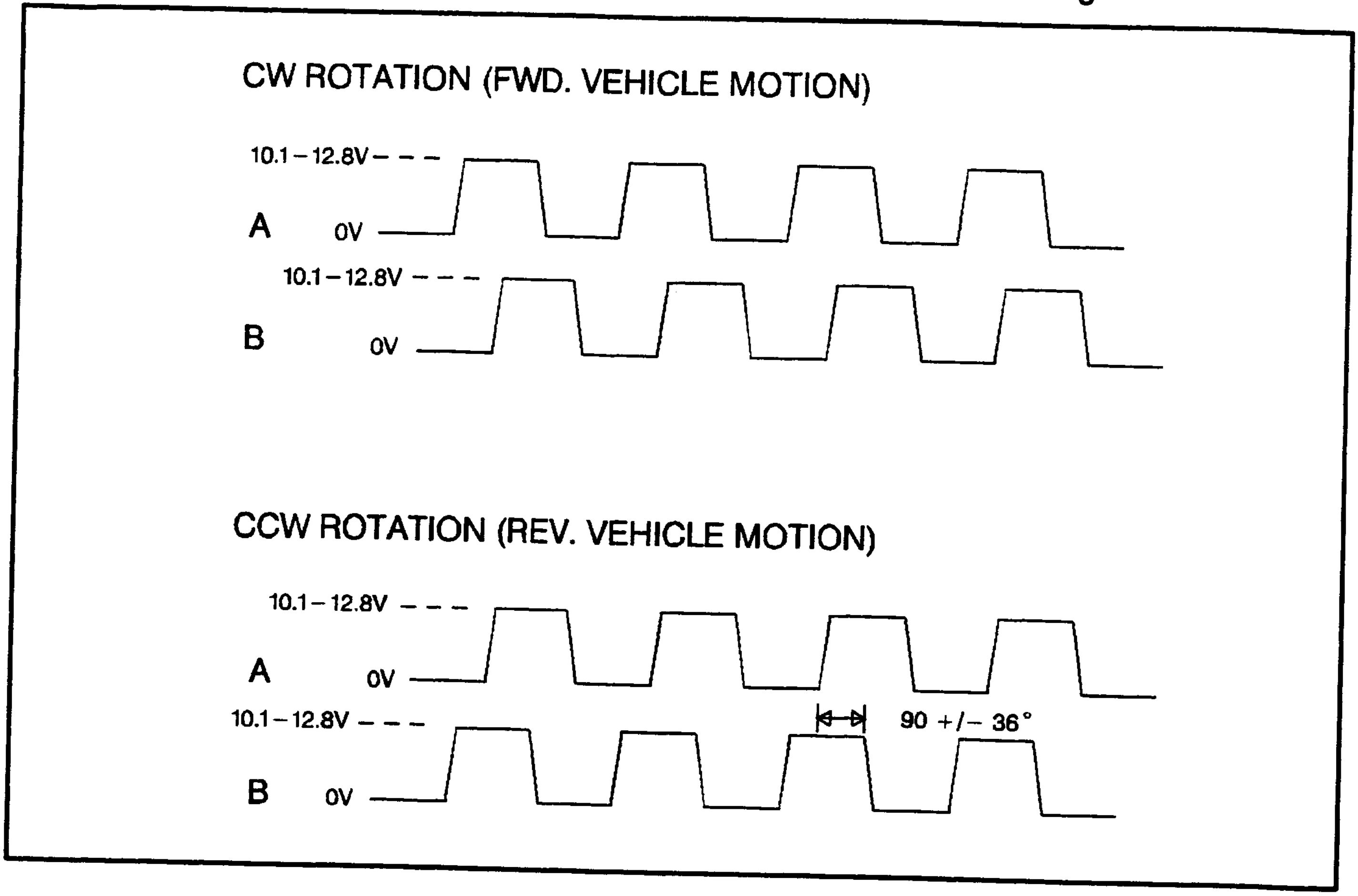
Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

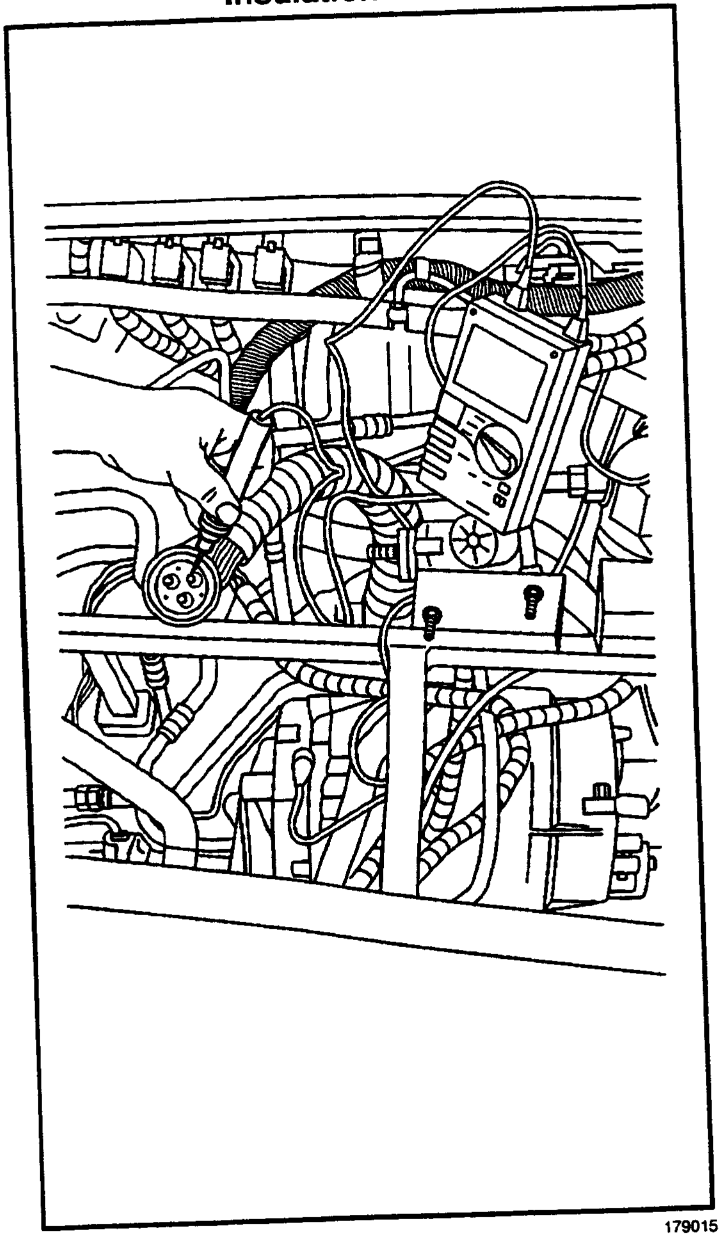
Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Drive Motor Speed and Direction Sensor Square Wave Signal



177151

Insulation Test



179015

Test Description

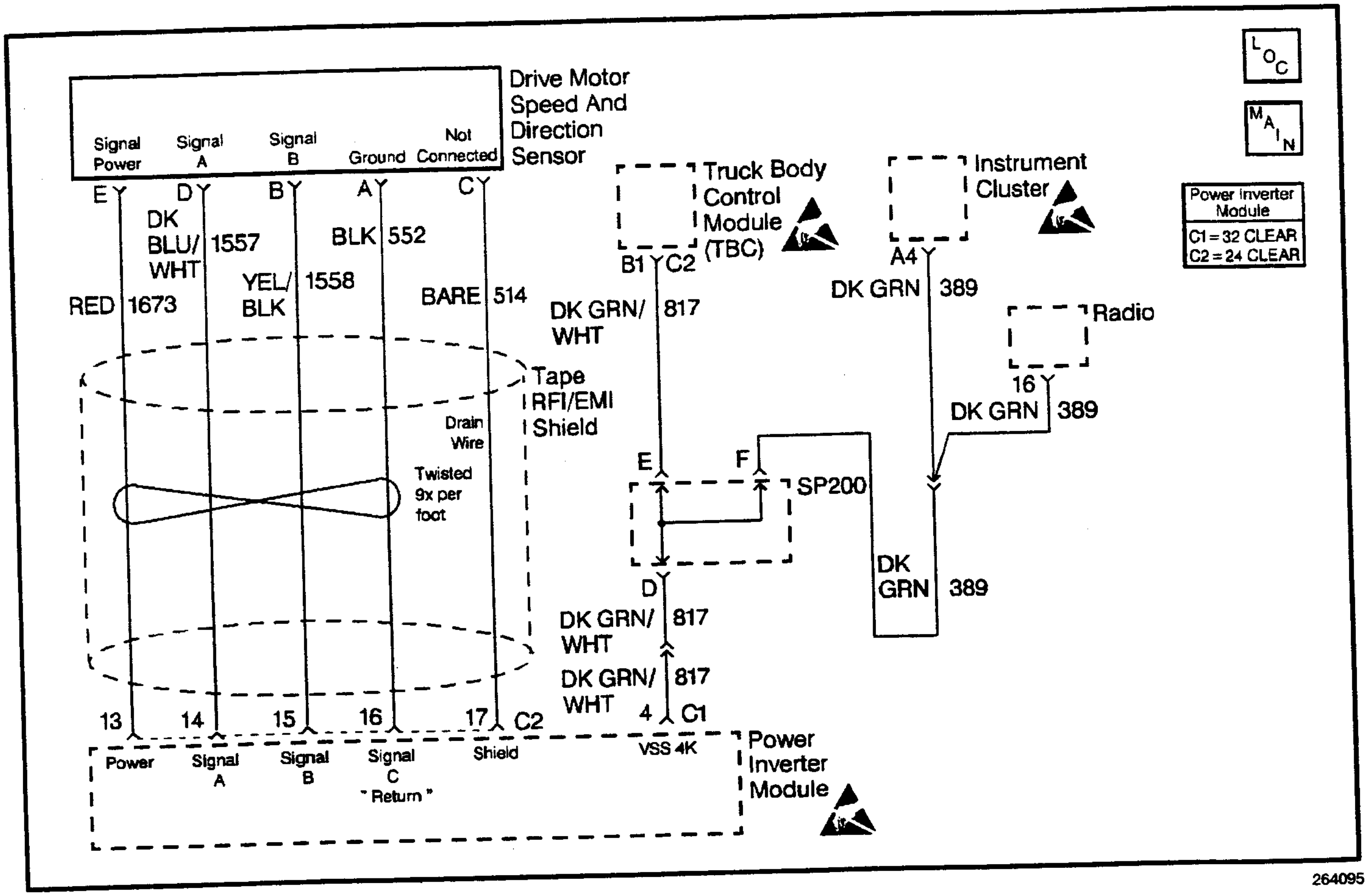
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current, this indicates a problem in the Power Inverter Module.

DTC 089 - Forward Control Circuit Failed Power-up

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool, check for current DTC 089. Is DTC 089 current?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled*** 1. Perform the high voltage disable procedure. 2. Remove the Power Inverter Module to drive motor cannon connector at the Power Inverter Module. 3. Using the Digital Insulation Tester J 42502, Clip the black lead to the drive motor housing. 4. Switch the Insulation tester J 42502 to the 1000 volts position. 5. Check each phase for an short condition buy turning the tester ON and probing each pin on the drive motor one at a time. Did each drive motor winding phase read equal to or greater then the specified resistance?	5M ohms	Go to Step 4	Go to Step 5
4	1. Place the Digital Insulation Tester J 42502 in the continuity position. 2. Place the ground probe on phase 1 of the drive motor winding and touch the positive probe end to phases 2 and 3 and record readings. 3. Place the ground probe on phase 2 and touch phase 3 with the positive probe and record reading. Were the resistance readings within the specified range?	1.8 - 2.2 ohms	Go to Step 6	Go to Step 5
5	Replace the drive motor. Refer to *Drive Motor and Front Axles replacement.* Is the action complete?	—	Go to Step 7	—
6	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 090 Reverse Control Circuit Failed Power-up


Drive Motor Speed And Direction Sensor
Signal Power
Signal A
Signal B
Ground
Not Connected
E
D
B
A
C
RED 1673
DK BLU/WHT 1557
YEL/BLK 1558
BLK 552
BARE 514
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
13
14
15
16
17
C2
Power
Signal A
Signal B
Signal C "Return"
Shield
VSS 4K
4
C1
Power Inverter Module
Truck Body Control Module (TBC)
B1
C2
DK GRN/WHT 817
E
F
SP200
D
DK GRN/WHT 817
DK GRN/WHT 817
Instrument Cluster
A4
DK GRN 389
Radio
16
DK GRN 389
DK GRN 389
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR

264095

Circuit Description

command a current and look for feedback it should be in range.

The Drive Motor Control Module sends to the BCA slip frequency and direction. It is passed by two signals Slip A and Slip B. When Slip A signal is leading Slip B signal this indicates the drive motor direction as forward. If Slip A lags Slip B this indicates the drive motor direction as reverse. The Drive Motor Control Module slip frequency is multiplied by 128 and used for the desired drive motor slip.

Conditions for Setting the DTC

- The BCA detects an invalid slip signal at power-up.

Action Taken When the DTC Sets

- The DTC will be stored in failure records buffer.
- Propulsion will be disabled.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function one ignition cycle after the fault is no longer present.

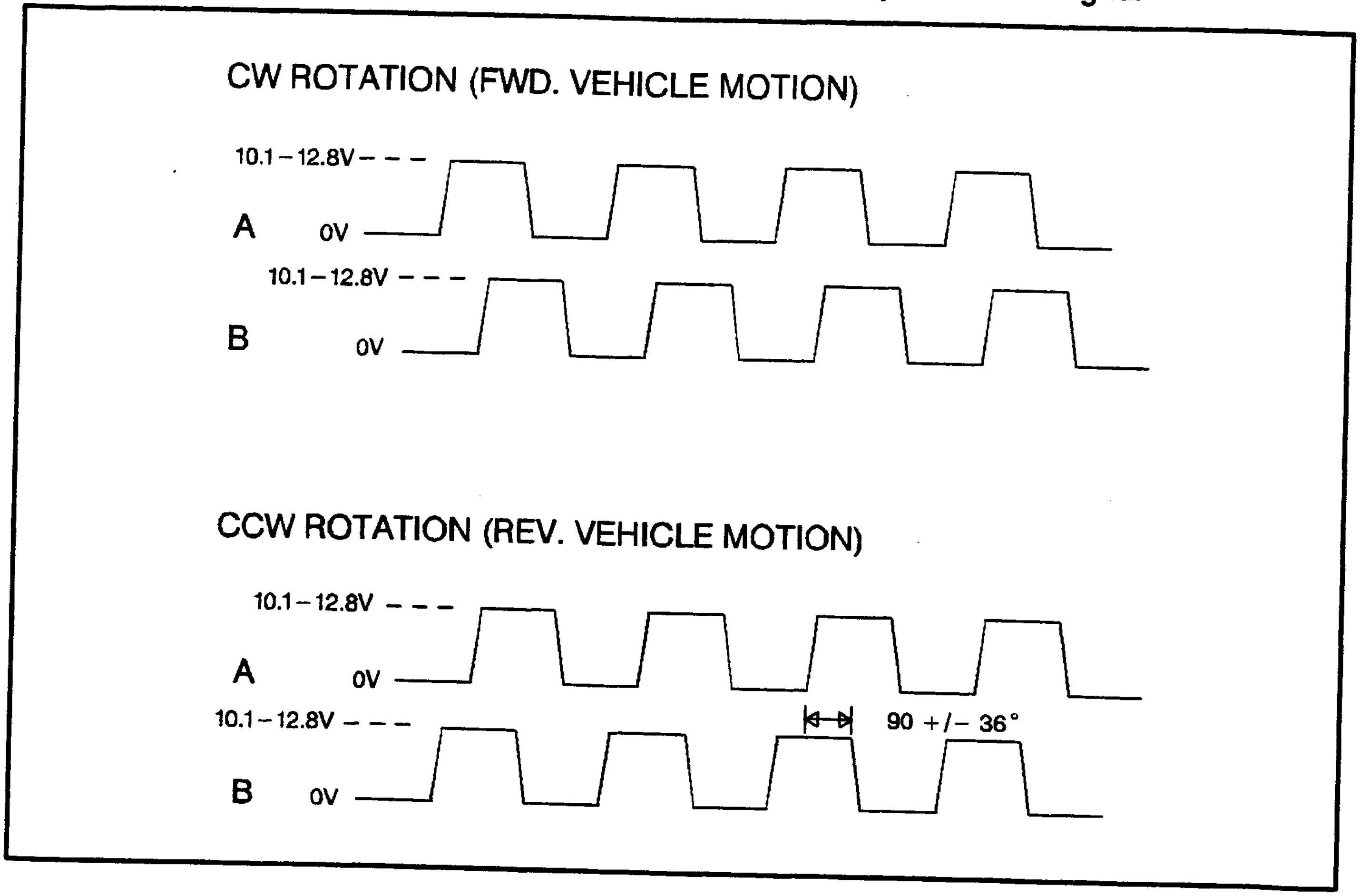
Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Drive Motor Speed and Direction Sensor Square Wave Signal



Test Description

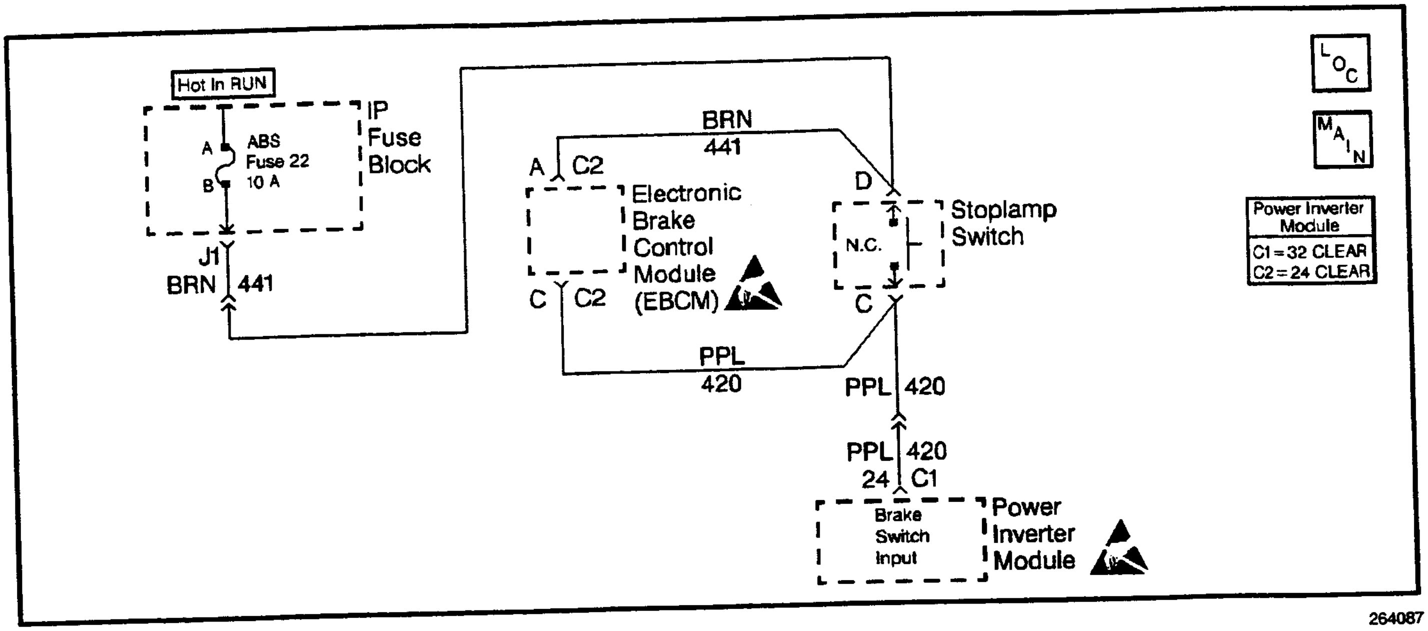
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current, this indicates a problem in the Power Inverter Module.

DTC 090 - Reverse Control Circuit Failed Power-up

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool, check for current DTC 090. Is DTC 090 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Replace the Power Inverter Module. Refer to *Power Inverter Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 095 Brake Switch Circuit Low


Hot In RUN
IP Fuse Block
A
ABS Fuse 22 10 A
B
J1
BRN 441
BRN 441
A C2
Electronic Brake Control Module (EBCM)
C C2
PPL 420
D
Stoplamp Switch
N.C.
C
PPL 420
PPL 420
24 C1
Brake Switch Input
Power Inverter Module
LOC
MAIN
Power Inverter Module
C1=32 CLEAR
C2=24 CLEAR
264087

Circuit Description

The Power Inverter Module Monitors a discrete input from the stoplamp switch. The stoplamp switch is a normally closed switch. The stoplamp switch receives a 12 volt power supply from the run 1 ignition. With the ignition in the RUN position and the brake pedal not depressed ignition voltage will be present at the Power Inverter Module. When the brake pedal is depressed the stoplamp switch will open and zero voltage will be present at the Power Inverter Module.

Conditions for Setting the DTC

- The Drive Motor Control Module detects zero voltage on the stoplamp input when brake pedal is not depressed.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE SOON lamp.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- The DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- Check for related EBCM DTC(s).
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

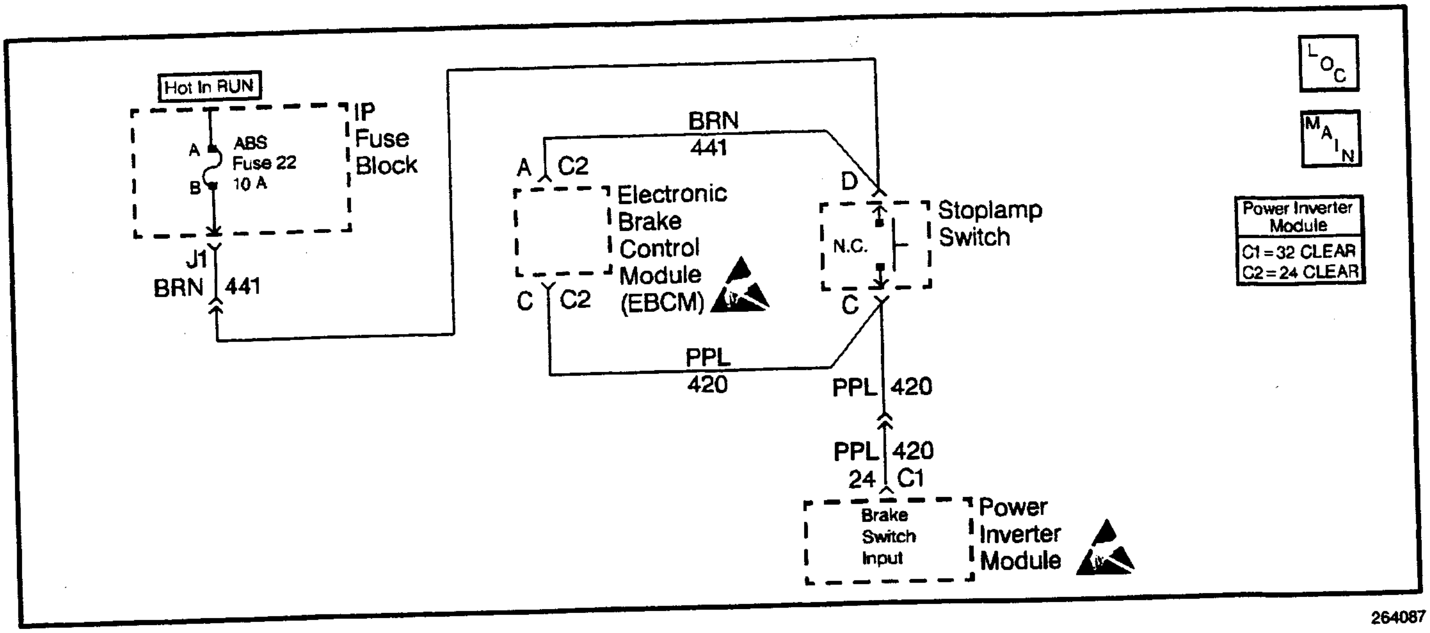
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for Electronic Brake control module DTC(s).
3. Checks the state of the brake switch.
5. Checks for power to the stoplamp switch.
7. Checks circuit 420 for an open condition.

DTC 095 Brake Switch Circuit Low

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to *OBD System Check*
2	Check for any related EBCM DTC(s) were any EBCM DTC(s) stored?	—	Go to other DTC(s) first	Go to Step 3
3	1. Connect a Scan Tool. 2. Turn the ignition ON. 3. Monitor the brake switch state. 4. Depress the brake pedal. Does the scan tool display brake switch OFF?	—	Go to Step 4	Go to Diagnostic Aids
4	Check stoplamp switch adjustment. Was a problem found?	—	Go to Step 13	Go to Step 5
5	1. Turn the ignition ON. 2. Disconnect the stoplamp switch connector. 3. With a test light connected to ground, probe terminal D of the stoplamp switch harness connector. Is the test light ON?	—	Go to Step 6	Go to Step 10
6	Jumper terminals C and D together at the stoplamp switch harness connector. Does the scan tool display brake switch OFF?	—	Go to Step 7	Go to Step 9
7	1. Disconnect the 32-way connector at the Power Inverter Module. 2. With a test light to ground probe terminal 24 at the Power Inverter Module 32-way connector. Is the test light ON?	—	Go to Step 8	Go to Step 12
8	Check for poor connections at the Power Inverter Module 32-way harness connector. Was a problem found?	—	Go to Step 11	Go to Step 14
9	Check for poor connections at the stoplamp switch harness connector. Was a problem found?		Go to Step 11	Go to Step 15
10	Open in circuit 441 to stoplamp switch. Repair the circuit as needed. Refer to *Electrical Diagnosis.* Is the repair complete?	—	Go to Step 16	—
11	Repair the circuit as needed. Refer to *Electrical Diagnosis.* Is the repair complete?	—	Go to Step 16	—
12	Open in circuit 420 to Power Inverter Module. Repair the circuit as needed. Refer to *Electrical Diagnosis.* Is the repair complete?	—	Go to Step 16	—
13	Adjust the stoplamp switch Is the action complete?	—	Go to Step 16	—
14	Replace the Power Inverter Module. Refer to Power Inverter Module Assembly Removal and Installation. Is the repair complete?	—	Go to Step 16	—
15	Replace the stoplamp switch assembly. Is the repair complete?	—	Go to Step 16	—
16	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 096 Brake Switch Circuit High



Hot In RUN
ABS Fuse 22 10 A
A
B
IP Fuse Block
J1
BRN 441
BRN 441
A C2
Electronic Brake Control Module (EBCM)
C C2
PPL 420
D
N.C.
C
Stoplamp Switch
PPL 420
PPL 420
24 C1
Brake Switch Input
Power Inverter Module
LOC
MAIN
Power Inverter Module
C1=32 CLEAR
C2=24 CLEAR
264087

Circuit Description

The Power Inverter Module Monitors a discrete input from the stoplamp switch. The stoplamp switch is a normally closed switch. The stoplamp switch receives a 12 volt power supply from the run 1 ignition. With the ignition in the RUN position and the brake pedal not depressed ignition voltage will be present at the Power Inverter Module. When the brake pedal is depressed the stoplamp switch will open and zero voltage will be present at the Power Inverter Module.

Conditions for Setting the DTC

- The Drive Motor Control Module detects voltage on the stoplamp input when brake pedal is depressed.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE SOON lamp.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- The DTC will clear and the vehicle will return to normal operation conditions 10 seconds after the fault is no longer present.
- The DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- Check for related EBCM DTC(s).
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

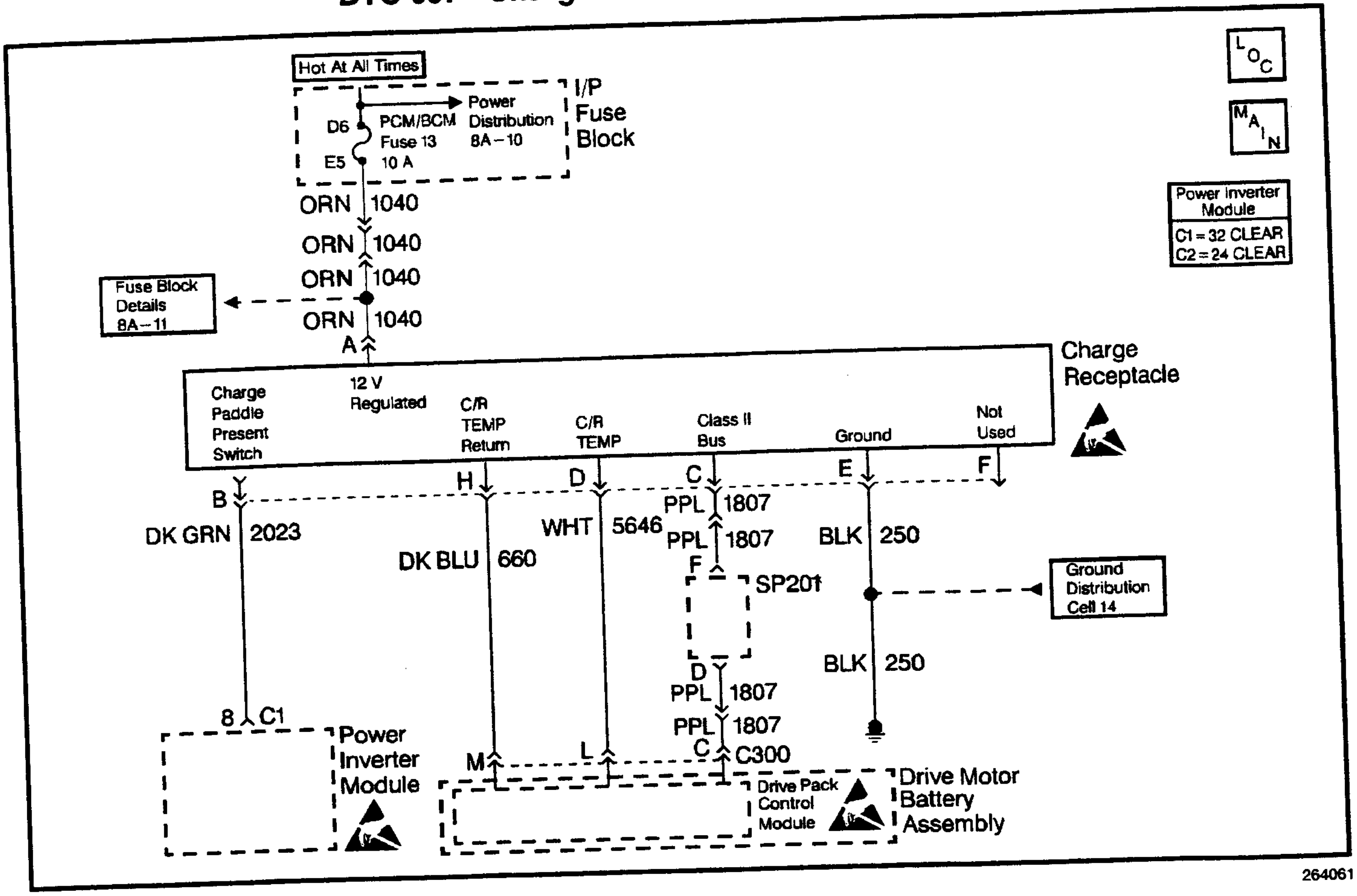
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for Electronic Brake control module DTC(s).
3. Checks the state of the brake switch.
6. Checks circuit 420 for an open condition.

DTC 096 Brake Switch Circuit High

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to *OBD System Check*
2	Check for any related EBCM DTC(s) were any EBCM DTC(s) stored?	—	Go to other DTC(s) first	Go to Step 3
3	1. Connect a Scan Tool. 2. Turn the ignition ON. 3. Monitor the brake switch state. 4. Brake pedal not depressed. Does the scan tool display brake switch ON?	—	Go to Step 4	Go to Diagnostic Aids
4	Check stoplamp switch adjustment. Was a problem found?	—	Go to Step 8	Go to Step 5
5	Disconnect the stoplamp switch connector. Does the scan tool display brake switch ON?	—	Go to Step 6	Go to Step 10
6	1. Disconnect the 32-way connector at the Power Inverter Module. 2. With a test light to ground probe terminal 24 at the PIM 32-way connector.. Is the test light ON?		Go to Step 7	Go to Step 9
7	Stoplamp switch signal circuit 420 is shorted to battery voltage. Repair the circuit as needed. Refer to *Electrical Diagnosis.* Is the repair complete?	—	Go to Step 11	—
8	Adjust the stoplamp switch Is the action complete?	—	Go to Step 11	—
9	Replace the Power Inverter Module. Refer to Power Inverter Module Assembly Removal and Installation. Is the repair complete?	—	Go to Step 11	—
10	Replace the stoplamp switch assembly. Is the repair complete?	—	Go to Step 11	—
11	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to *OBD systems check*	—

DTC 097 - Charge Paddle Present Correlation


Hot At All Times
I/P Fuse Block
D6
E5
PCM/BCM Fuse 13 10 A
Power Distribution 8A-10
ORN 1040
ORN 1040
ORN 1040
ORN 1040
Fuse Block Details 8A-11
A
Charge Receptacle
Charge Paddle Present Switch
12 V Regulated
C/R TEMP Return
C/R TEMP
Class II Bus
Ground
Not Used
B
H
D
C
E
F
DK GRN 2023
DK BLU 660
WHT 5646
PPL 1807
PPL 1807
BLK 250
F
SP201
Ground Distribution Cell 14
BLK 250
D
PPL 1807
PPL 1807
8 C1
Power Inverter Module
M
L
C
C300
Drive Pack Control Module
Drive Motor Battery Assembly
LOC
MAIN
Power Inverter Module
C1=32 CLEAR
C2=24 CLEAR
264061

Circuit Description

The Battery Pack Control Module and the Drive Motor Control Module monitor the charge receptacle to indicate if the charge coupler is present. The Drive Motor Control Module and Battery Pack Control Module look at two different switches to determine if the coupler is present and compare there results over serial data.

Conditions for Setting the DTC

- Paddle present switches disagree for greater than 30 sec.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE SOON light.
- DTC will be stored in failure records buffer.
- Propulsion is disabled.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- The DTC can be cleared by using the scan tool Clear Info function

Diagnostic Aids

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

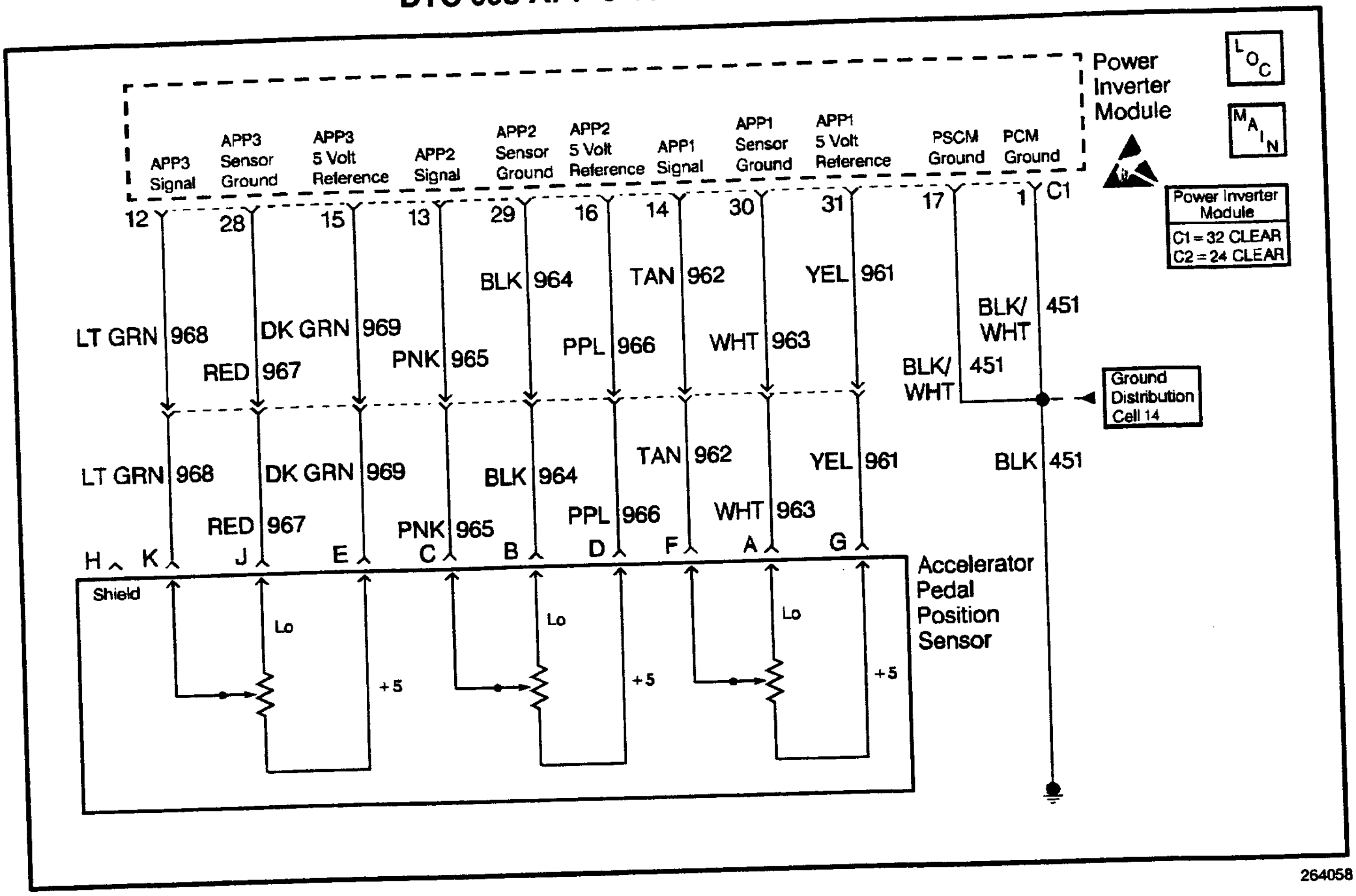
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This fault will result in a Battery Pack Control Module DTC 287. Refer to Battery Pack Control Module chart 287.

DTC 097 Charge Paddle Present Correlation

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Refer to Battery Pack Control Module DTC 287	—	Go to Step 3	—
3	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 098 APP 5 Volt Reference 2 Low


Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
C1
12
28
15
13
29
16
14
30
31
17
1
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
BLK/WHT 451
Ground Distribution Cell 14
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Lo
+5
Lo
+5
Accelerator Pedal Position Sensor
264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 4.2 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 0.8 volts at WOT. Sensor 3 varies from 4.0 volts at closed position to about 1.9 volts at WOT. The Drive Motor Control Module re-scales each of the channels and then compares each channel to the other two in order to detect in-range sensor faults. The Drive Motor Control Module monitors the supply voltage on sensors 2 and 3.

Conditions for Setting the DTC

- Drive Motor Control Module sees less than 3.5 volts for 16 milliseconds.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE SOON light.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- The DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

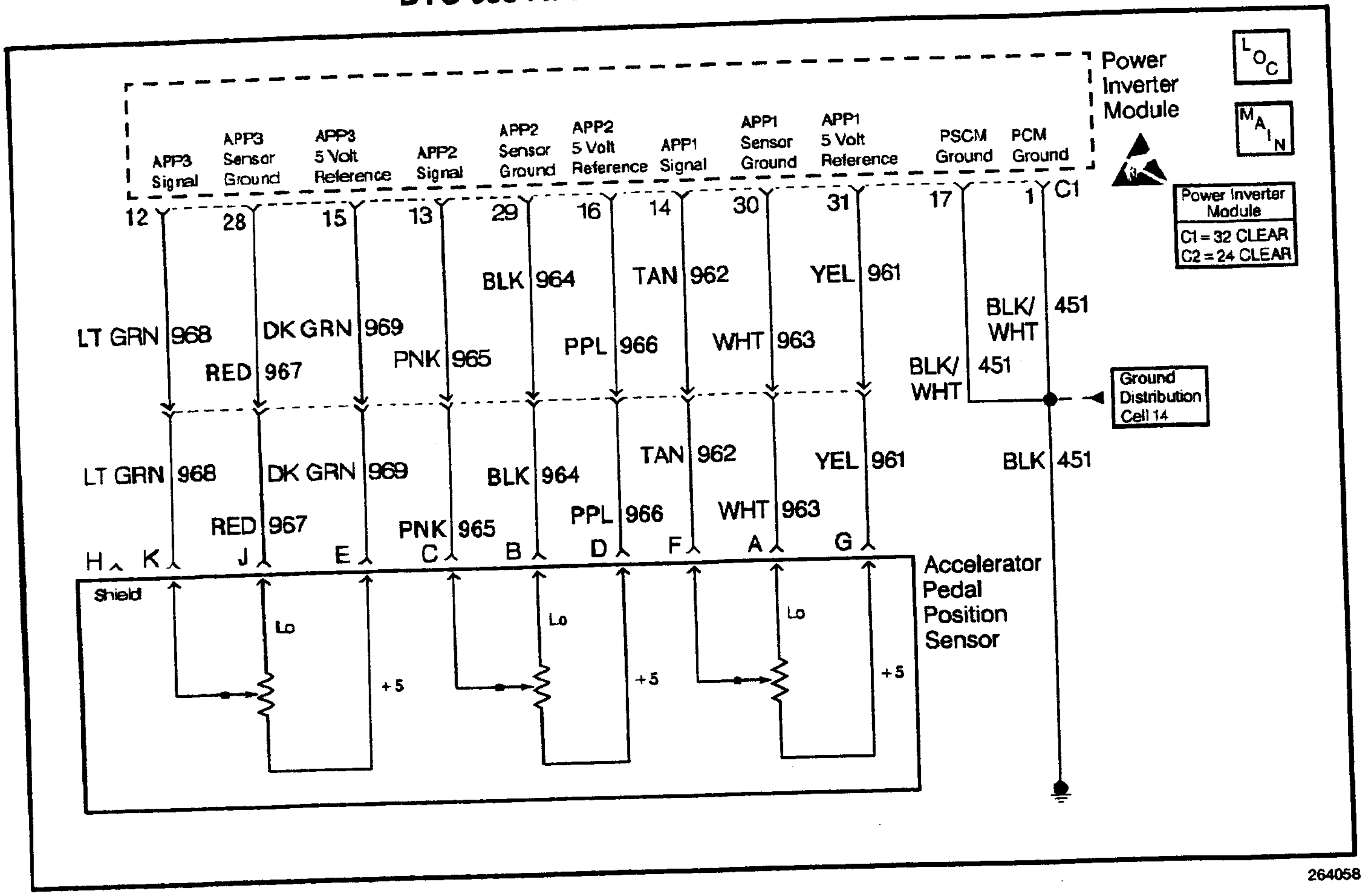
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for the 5 volt reference.

DTC 098 APP 5 Volt Reference 2 Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Disconnect the 32-way connector at the Power Inverter Module. 2. Turn the ignition ON. 3. Using a DMM, read the voltage between pins 16 and 29 on the Power Inverter Module. Is the voltage at or above the specified value?	4.5V	Go to Step 3	Go to Step 6
3	1. Turn the ignition OFF. 2. Disconnect the APP sensor harness connector. 3. Check the APP2 sensor 5 volt reference circuit for a short to ground. Was the APP2 sensor 5 volt reference circuit shorted to ground?	—	Go to Step 4	Go to Step 5
4	Repair short to ground on circuit 966. Is action complete?	—	Go to Step 7	—
5	Replace the APP module. Refer to *APP removal and replacement.* Is the action complete?	—	Go to Step 7	—
6	Replace the faulty Drive Motor Control Module. Notice: If the Drive Motor Control Module is faulty, the new Drive Motor Control Module must be programmed. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 099 APP 5 Volt Reference 2 High


Power Inverter Module
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
12
28
15
13
29
16
14
30
31
17
1
C1
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
Ground Distribution Cell 14
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Accelerator Pedal Position Sensor
264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 4.2 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 0.8 volts at WOT. Sensor 3 varies from 4.0 volts at closed position to about 1.9 volts at WOT. The Drive Motor Control Module re-scales each of the channels and then compares each channel to the other two in order to detect in-range sensor faults. The Drive Motor Control Module monitors the supply voltage on sensors 2 and 3.

Conditions for Setting the DTC

- The Drive Motor Control Module sees more than 5.4 volts for 16 milliseconds.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE SOON lamp.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- The DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

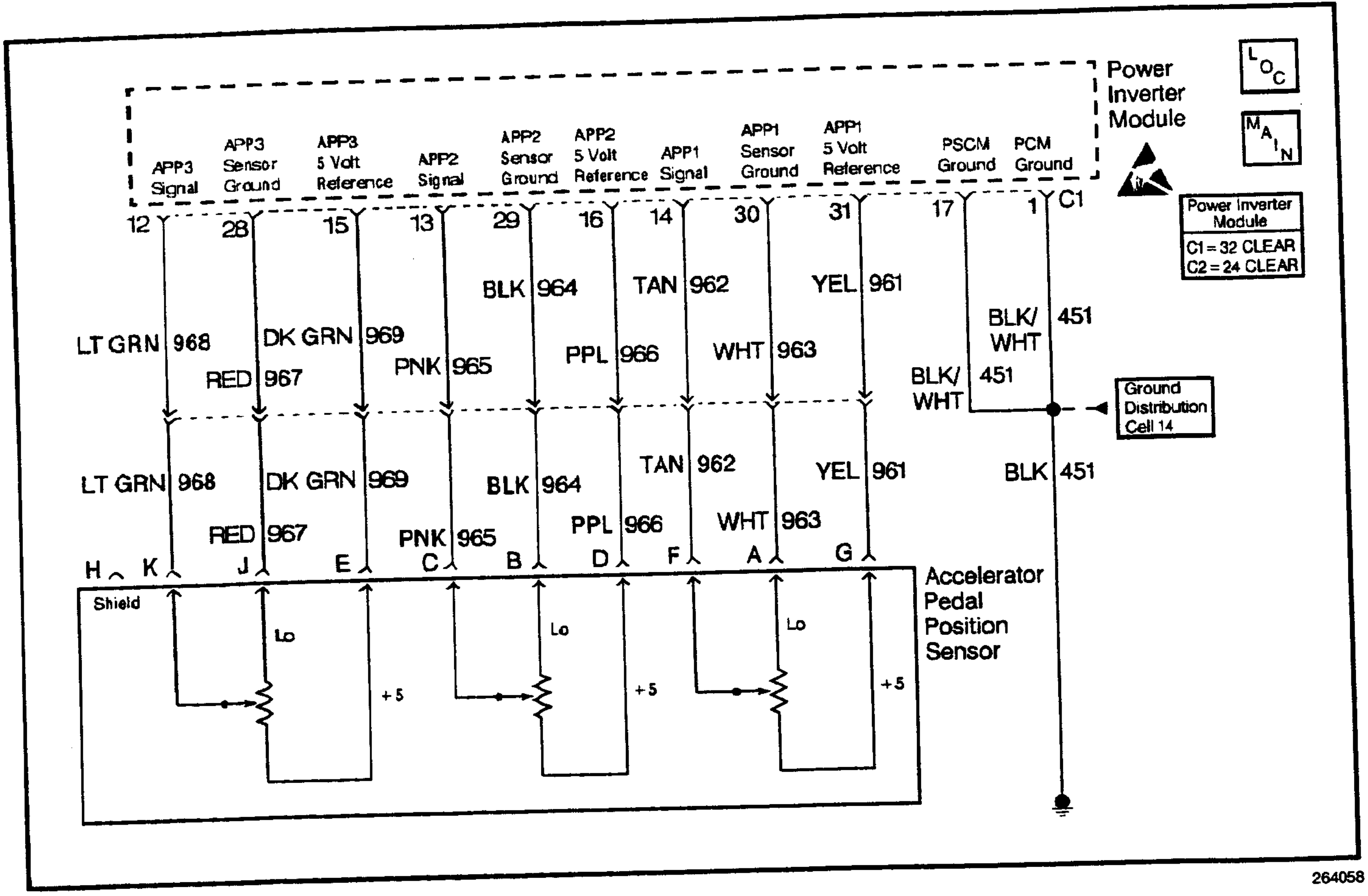
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for the 5 volt reference.
3. This step checks for the correct voltage output of the Power Inverter Module to the APP sensor.

DTC 099 APP 5 Volt Reference 2 High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Disconnect the APP sensor harness connector. 2. Ignition ON. 3. Check the APP2 sensor 5 volt reference circuit 966 with DMM to ground. Is the voltage at or above the specified value?	5.4V	Go to Step 3	Go to Diagnostic Aids
3	1. Ignition OFF 2. Disconnect the 32-way connector at the Power Inverter Module. 3. Ignition ON. 4. Using a DMM, read the voltage between pins 16 and 29 on the Power Inverter Module. Is the voltage at or above the specified value?	5.4 V	Go to Step 5	Go to Step 4
4	Repair short to voltage on circuit 966. Is action complete?	—	Go to Step 6	—
5	Replace the faulty Drive Motor Control Module. Notice: If the Drive Motor Control Module is faulty, the new Drive Motor Control Module must be programmed. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 100 APP 5 Volt Reference 3 Low


Power Inverter Module
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
12
28
15
13
29
16
14
30
31
17
1
C1
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
BLK/WHT 451
Ground Distribution Cell 14
BLK 451
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Lo
+5
Lo
+5
Accelerator Pedal Position Sensor
264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 4.2 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 0.8 volts at WOT. Sensor 3 varies from 4.0 volts at closed position to about 1.9 volts at WOT. The Drive Motor Control Module monitors the supply voltage on sensors 2 and 3.

Conditions for Setting the DTC

- The Drive Motor Control Module reads less then 3.5 volts for 16 milliseconds.

Action Taken When the DTC Sets

- The Drive Motor Control Module will turn on the SERVICE SOON light.
- The DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle.

Diagnostic Aids

Check for the following conditions:

- Inspect for pinched or damaged wires.
- Inspect for loose or damaged connectors.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

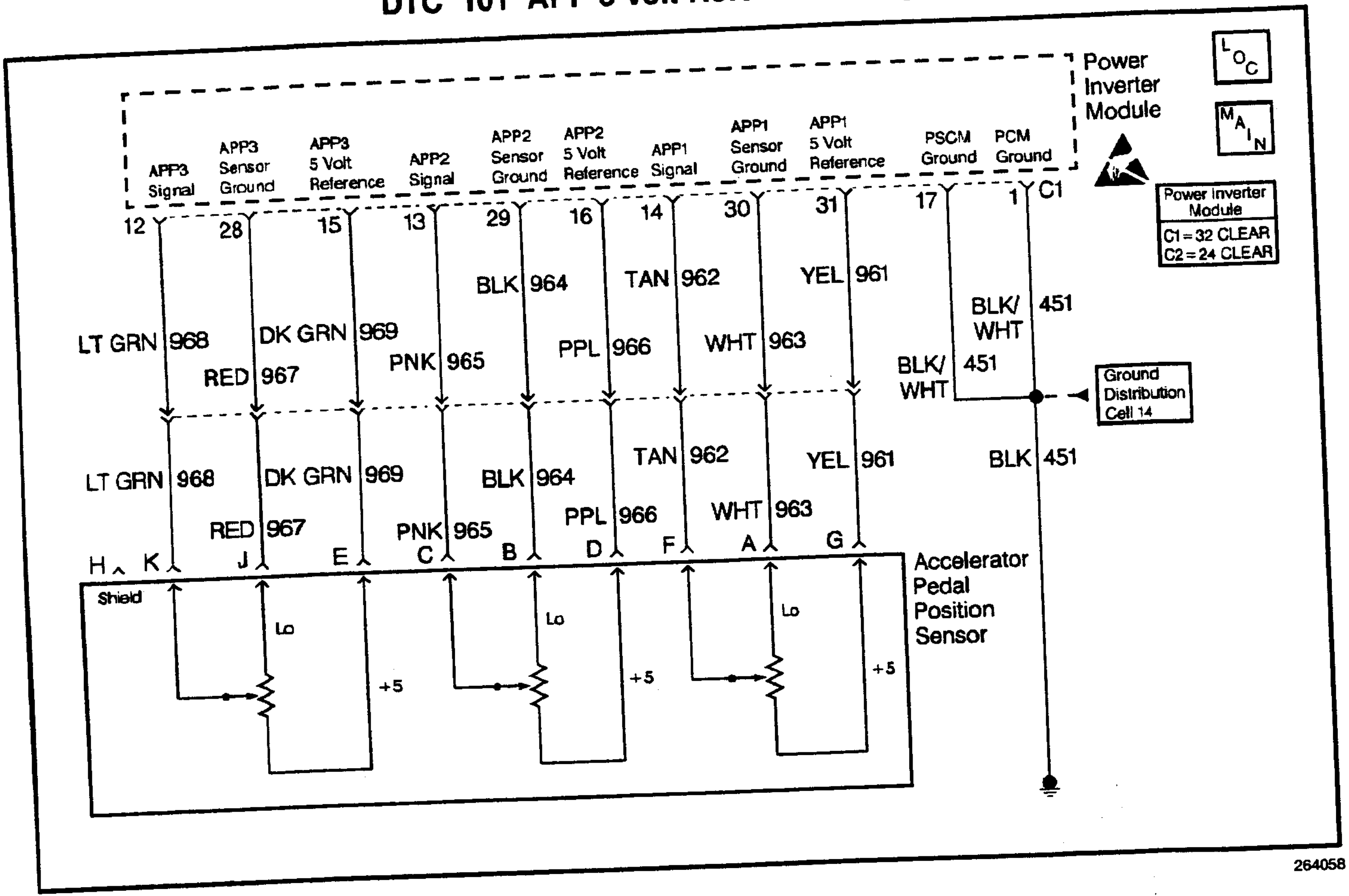
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for 5 volt reference and ground at the Power Inverter Module.
3. Checks for short to ground of 5 volt reference on APP 3.

DTC 100 APP 5 Volt Reference 3 Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Disconnect the 32-way connector at the Power Inverter Module. 2. Ignition ON. 3. Using a DMM read the voltage between pins 15 and 28 on the Power Inverter Module. Is the voltage at or above the specified value?	4.5V	Go to Step 3	Go to Step 6
3	1. Ignition OFF. 2. Disconnect the APP sensor harness connector. 3. Check the APP3 sensor 5 volt reference circuit for an short to ground. Was the APP3 sensor 5 volt reference circuit shorted to ground?	—	Go to Step 4	Go to Step 5
4	Repair short to ground on circuit 969. Is action complete?	—	Go to Step 7	—
5	Replace the APP module. Is the action complete?	—	Go to Step 7	—
6	Replace the faulty Drive Motor Control Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 101 APP 5 Volt Reference 3 High


Power Inverter Module
L O C
M A I N
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
APP3 Signal
APP3 Sensor Ground
APP3 5 Volt Reference
APP2 Signal
APP2 Sensor Ground
APP2 5 Volt Reference
APP1 Signal
APP1 Sensor Ground
APP1 5 Volt Reference
PSCM Ground
PCM Ground
12
28
15
13
29
16
14
30
31
17
1
C1
LT GRN 968
RED 967
DK GRN 969
PNK 965
BLK 964
PPL 966
TAN 962
WHT 963
YEL 961
BLK/WHT 451
BLK 451
Ground Distribution Cell 14
H
K
J
E
C
B
D
F
A
G
Shield
Lo
+5
Accelerator Pedal Position Sensor
264058

Circuit Description

The Accelerator Pedal Position (APP) sensor module consists of three potentiometers which provide voltages proportional to the pedal position. Sensor 1 varies from 0.5 volts at closed position to about 4.2 volts at WOT. Sensor 2 varies from about 4.3 volts at closed position to about 0.8 volts at WOT. Sensor 3 varies from 4.0 volts at closed position to about 1.9 volts at WOT. The Drive Motor Control Module monitors the supply voltage on sensors 2 and 3.

Conditions for Setting the DTC

- The Drive Motor Control Module reads less then 5.4 volts for 16 milliseconds.

Action Taken When the DTC Sets

- The Drive Motor Control Module will turn on the SERVICE SOON light.
- The DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after one ignition cycle.

Diagnostic Aids

Check for the following conditions:

- Inspect for pinched or damaged wires.
- Inspect for loose or damaged connectors.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for the 5 volt reference.

DTC 101 APP 5 Volt Reference 3 High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Disconnect the APP sensor harness connector. 2. Ignition ON. 3. Check the APP3 sensor 5 volt reference circuit 969 with DMM to ground. Is the voltage at or above the specified value?	5.4V	Go to Step 3	Go to Diagnostic Aids
3	1. Ignition OFF 2. Disconnect the 32-way connector at the Power Inverter Module. 3. Ignition ON. 4. Using a DMM, read the voltage between pins 15 and 28 on the Power Inverter Module. Is the voltage at or above the specified value?	5.4 V	Go to Step 5	Go to Step 4
4	Repair short to voltage on circuit 969. Is action complete?	—	Go to Step 6	—
5	Replace the faulty Drive Motor Control Module. Refer to Power Inverter Module replacement and programming procedures in this section. Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 102 - Reduced Performance State of Charge Low

Circuit Description

When the Battery Pack Control Module detects a battery over voltage or under voltage it will send a request via serial data to the Drive Motor Control Module to enable reduced performance. The Drive Motor Control Module will reduce the vehicle performance by a calibrated amount. This action will protect the battery pack.

Conditions for Setting the DTC

- The Battery Pack Control Module requests vehicle to reduced performance mode due to a over or under voltage in the battery pack.

Action Taken When the DTC Sets

- Performance is reduced.
- Cruise control is disabled.
- The DTC will be stored in the failure records buffer.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function when the fault is no longer present.

Diagnostic Aids

Check for the following conditions:

- This DTC will only set in conjunction with Battery Pack Control Module over or under voltage DTC(s) commanding reduced performance.
- If this DTC sets without any Battery Pack Control Module codes, suspect the Drive Motor Control Module.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

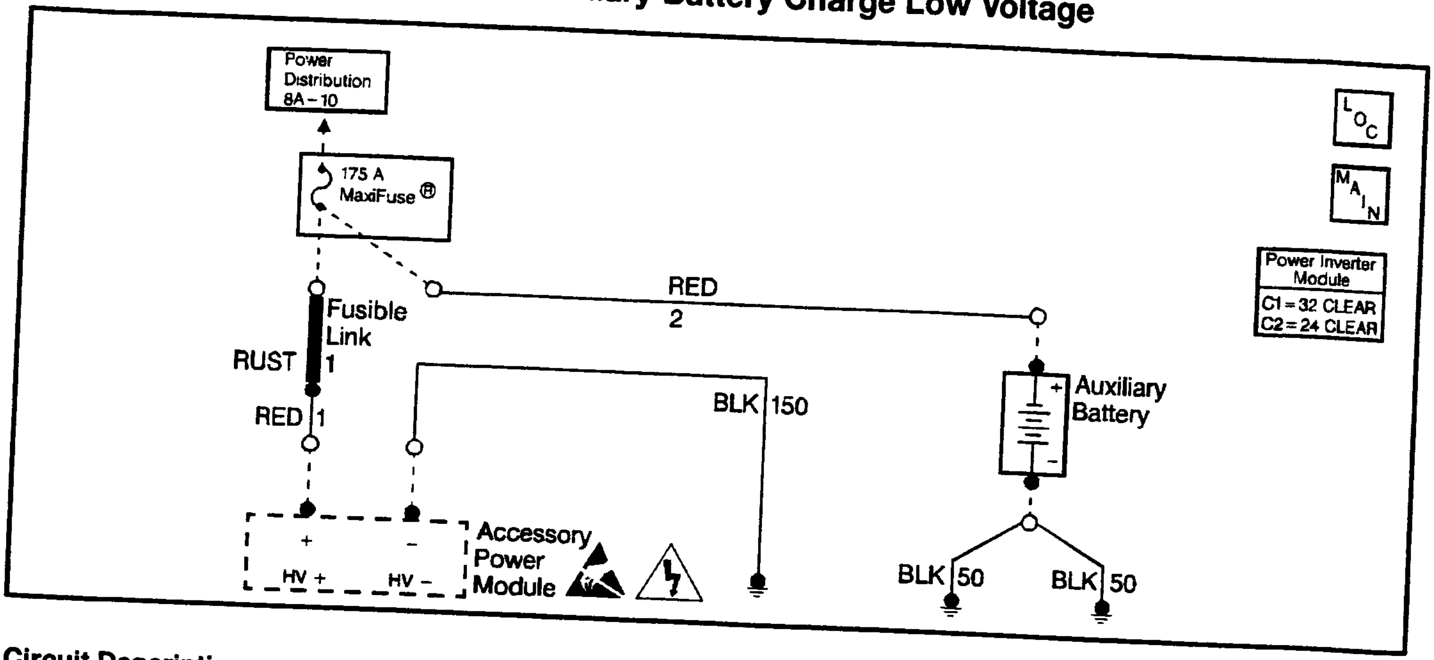
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for BPCM DTC(s) first.
3. This step checks for other DMCM DTC(s) first.

DTC 102 - Reduced Performance State of Charge Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Were any other Battery Pack Control Module DTCs set?	—	Go to other DTCs first	Go to Step 3
3	Were any other Drive Motor Control Module DTCs set?	—	Go to Step 4	Go to Diagnostic Aids
4	Go to other DTCs first. Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 104 Auxiliary Battery Charge Low Voltage



264080

Circuit Description

Whenever the Accessory Power Control Module is awake it provides a constant DC supply to the auxiliary battery which supplies power to the 12 volt system. This DC voltage keeps the auxiliary battery charged during vehicle operation. Normal operating voltage is 13.5 to 14.5 volts. The Drive Motor Control Module monitors the Run 1 input to determine Aux. battery voltage.

Conditions for Setting the DTC

- Ignition ON.
- Drive Motor Control Module senses Aux. Battery voltage less than 12.5 volts for 30 seconds.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE NOW light.
- The DTC will be stored in failure records.

Conditions for Clearing the DTC

- The Drive Motor Control Module will turn the SERVICE NOW light OFF 10 seconds after the diagnostic has been run and the fault condition is no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Check for loose, damaged or corroded terminals on the Run 1 circuit to the Drive Motor Control Module.
- The Accessory Power Control Module may temporarily shut down if to much current is being used. Allowing the vehicle to stand with the ignition OFF will bring Accessory Power Control Module power supply back if the fault condition no longer exists.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks auxiliary battery voltage with a scan tool.
3. This step checks AC voltage output at the Accessory Power Control Module.

DTC 104 Auxiliary Battery Charge Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using the scan tool view Drive Motor Control Module Aux. battery voltage. Is Drive Motor Control Module Aux. battery voltage at or above the specified value?	13 V	Go to Diagnostic Aids	Go to Step 3

DTC 104 Auxiliary Battery Charge Low Voltage (continued)

Step	Action	Value(s)	Yes	No
3	1. Turn the ignition ON. 2. Using a DMM, measure the voltage at the Aux. battery. Is the voltage at or above the specified value?	13 V	Go to Step 7	Go to Step 4
4	1. Turn the ignition OFF. 2. Using a DMM, measure the voltage at the Aux. battery. Does the DMM measure Aux. battery voltage at or below the specified value?	9.5 V	Go to Step 5	Go to Step 6
5	Charge and test the Aux. battery with a standard battery charger. Refer to *Auxiliary Battery.* Did the Aux. battery pass the load test?	—	Go to Step 6	Go to Step 10
6	1. Turn the ignition OFF. 2. Disconnect the positive Aux. battery cable at the Aux. battery. 3. Disconnect the positive Aux. battery cable at the Accessory Power Control Module. 4. Turn the ignition ON. 5. Using a DMM, measure the voltage between the positive terminal at the Accessory Power Control Module and ground. Is the voltage at or above the specified value?	14 V	Go to Step 9	Go to Step 11
7	1. Turn the ignition OFF. 2. Disconnect the 32-way connector at the Power Inverter Module. 3. Turn the ignition ON. 4. Using a DMM, measure the voltage at the 32-way connector terminal 20 on the harness side to ground. Is the voltage at or above the specified value?	13 V	Go to Step 12	Go to Step 8
8	Repair high resistance in the Run 1 circuit to the Power Inverter Module. Is the action complete?	—	Go to Step 13	—
9	Repair or replace positive or negative Aux. battery cables or connection. Is the action complete?	—	Go to Step 13	—
10	Replace the Aux. battery. Refer to *Auxiliary battery.* Is the action complete?	—	Go to Step 13	—
11	Replace the Accessory Power Control Module. Refer to *Accessory Power Module Removal and Installation procedure.* Is the action complete?	—	Go to Step 13	—
12	Replace the faulty Drive Motor Control Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 13	—
13	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 105 - High Voltage Discharge Circuit Voltage High

Circuit Description

Caution: This DTC may indicate high voltage present from the battery assembly even with the high voltage disconnect removed. Always treat high voltage cables and the Power Inverter Module as though high voltage is present.

All of the high voltage DC connectors and cover switches are tied together in an isolated series single wire interlock loop. The Drive Motor Control Module monitors the high voltage interlock loop circuit. If the loop is broken anywhere, the Power Inverter Module will discharge the bus capacitors so that the bus voltage is less than 42.4 volts within 250 ms of high voltage interlock loop interruption detection. The Drive Motor Control Module monitors the scaled (100 volts = 1 volt) circuit to ensure the voltage drops below 42.5 volts when the interlock loop is open for 250 ms.

Conditions for Setting the DTC

- Ignition on
- High voltage interlock is open for longer then 250 milliseconds.
- Drive Motor Control Module sensed voltage greater then 42.5 volts on the high voltage bus.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE SOON light.
- The DTC will be stored in failure records.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Caution: This DTC may indicate high voltage present from the battery assembly even with the high voltage disconnect removed. Always treat high voltage cables and the Power Inverter Module as though high voltage is present.

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

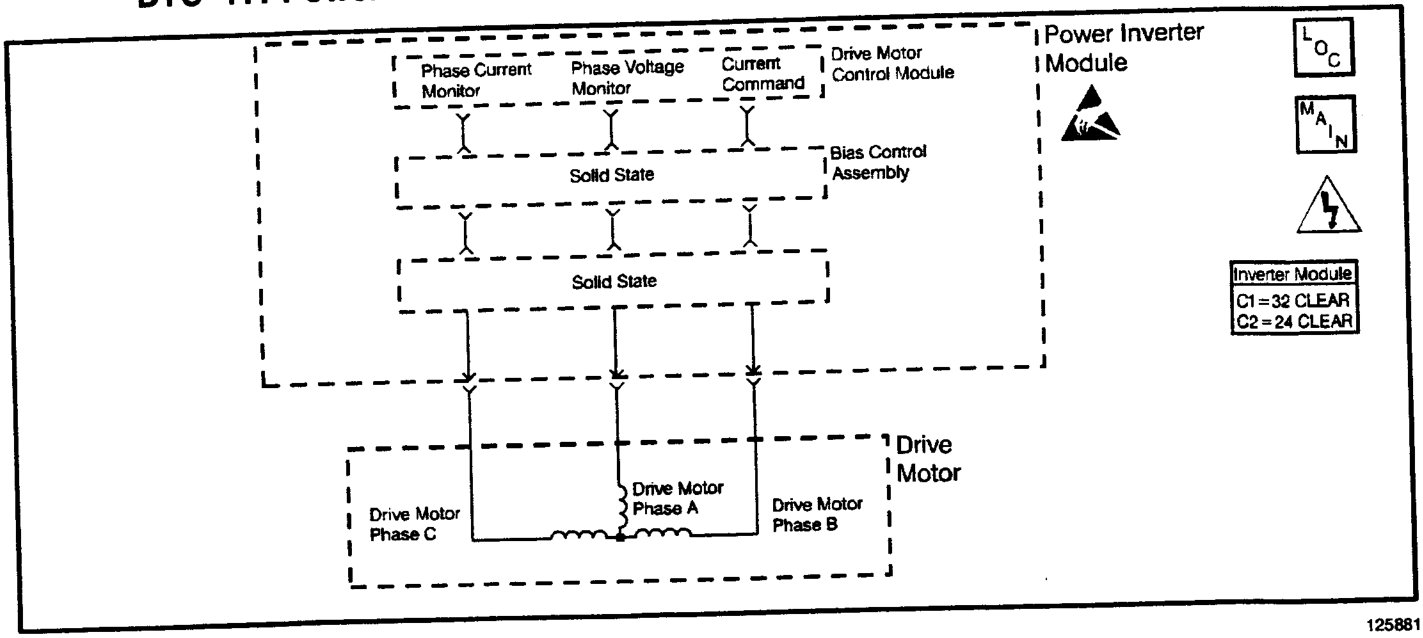
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks to verify that the fault is present. If the fault is present, the problem is internal to the PIM.

DTC 105 - High Voltage Discharge Circuit Voltage High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault present?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: This DTC may indicate high voltage present from the battery assembly even with the high voltage disconnect removed. Always treat high voltage cables and the Power Inverter Module as though high voltage is present.*** Perform the High Voltage Disable Procedure as outlined in the beginning of this section. Is the action complete?	—	Go to Step 4	—
4	Replace the Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 111 Power Inverter Module Bias Control Phase Voltage Out of Range


Power Inverter Module
Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Solid State
Bias Control Assembly
Solid State
Drive Motor
Drive Motor Phase A
Drive Motor Phase C
Drive Motor Phase B
LOC
MAIN
Inverter Module
C1=32 CLEAR
C2=24 CLEAR

125881

Circuit Description

Any time vehicle speed is below 10 Mph and no related DTCs are set, the Drive Motor Control Module will run a voltage test. The Drive Motor Control Module will look for phase voltage feedback signal to be less than 25% of maximum phase voltage.

Conditions for Setting the DTC

- Auto disconnect closed.
- Vehicle speed is less then 10 mph.
- Phase voltage feedback signal is greater than 25% of maximum phase voltage.

Action Taken When the DTC Sets

- Drive Motor Control Module will illuminate the SERVICE NOW light.
- The DTC will be stored in failure records.
- Propulsion will be disabled.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function when the fault is no longer present.

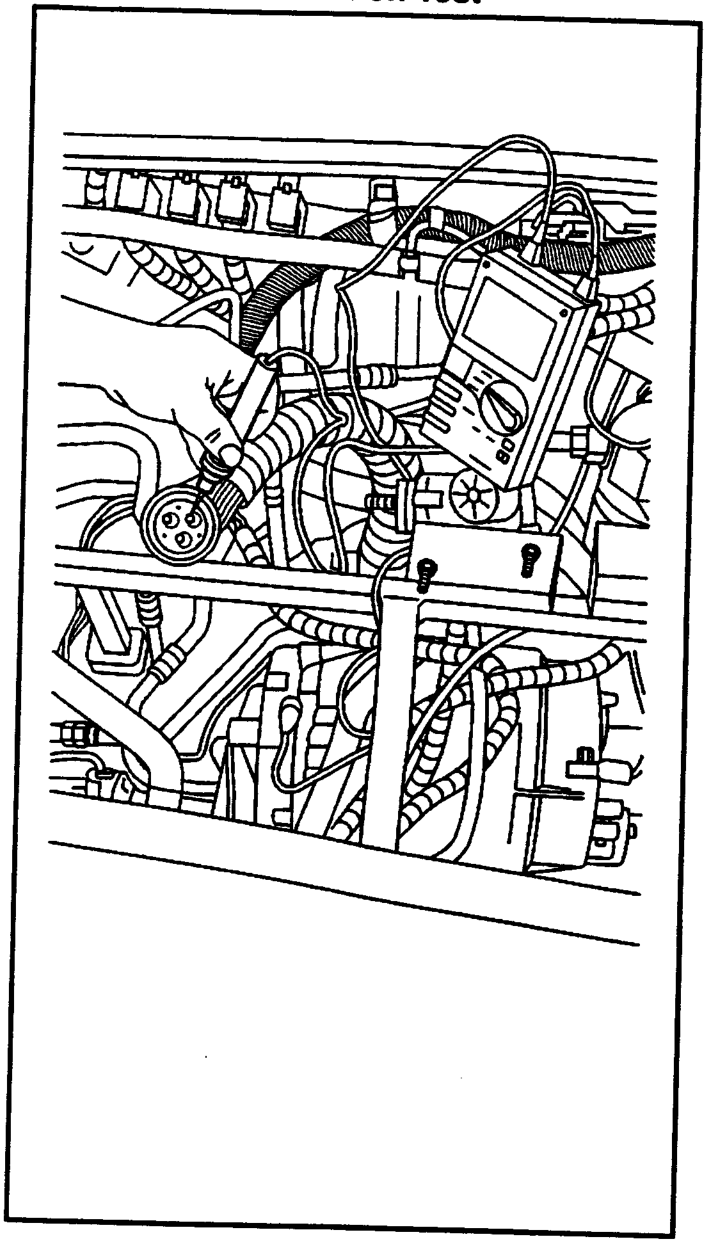
Diagnostic Aids

Check for the following conditions:

- If the fault is present the vehicle may feel rough during acceleration.
- Reproducing this fault condition may require the drive motor and or Power Inverter Module to be at operating temperature.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Insulation Test



179015

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks for phase voltage leakage to ground.
4. This checks for and open between the phase windings.

DTC 111 Power Inverter Module Bias Control Phase Voltage Out of Range

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Capture failure records data. 2. Clear DTCs. 3. Drive Vehicle in the range described in failure records. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled*** 1. Perform the high voltage disable procedure. 2. Remove the Power Inverter Module to drive motor cannon connector at the Power Inverter Module. 3. Using the Digital Insulation Tester J 42502, Clip the black lead to the drive motor housing. 4. Switch the Insulation tester J 42502 to the 1000 volts position. 5. Check each phase for an short condition buy turning the tester ON and probing each pin on the drive motor one at a time. Did each drive motor winding phase read equal to or greater then the specified resistance?	5M ohms	Go to Step 4	Go to Step 5
4	1. Place the Digital Insulation Tester J 42502 in the continuity position. 2. Place the ground probe on phase 1 of the drive motor winding and touch the positive probe end to phases 2 and 3 and record readings. 3. Place the ground probe on phase 2 and touch phase 3 with the positive probe and record reading. Were the resistance readings within the specified range?	1.8 - 2.2 ohms	Go to Step 6	Go to Step 5
5	Replace the drive motor. Refer to *Drive Motor and Front Axles replacement.* Is the action complete?	—	Go to Step 7	—
6	Replace the Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 112 - Output Control 1 Performance

Circuit Description

A quad driver module (QDM) is an electronic switch which completes a ground circuit when switched on. The QDM independently controls four separate outputs. A load is connected between battery voltage and the QDM allowing the driver to control the output. The QDM has only one fault line that will detect a fault on any of the four outputs. All circuits on this QDM are internal to the Drive Motor Inverter Module and are not serviceable.

Conditions for Setting the DTC

The Drive Motor Control Module detects an open, short to ground or short to voltage on any of the QDM output circuits for greater then 0.25 seconds.

- Power up enable command circuit
- Current command to BCA circuit
- Slip A to BCA circuit
- Slip B to BCA circuit

Action Taken When the DTC Sets

- Drive Motor Control Module will turn on the SERVICE SOON light.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

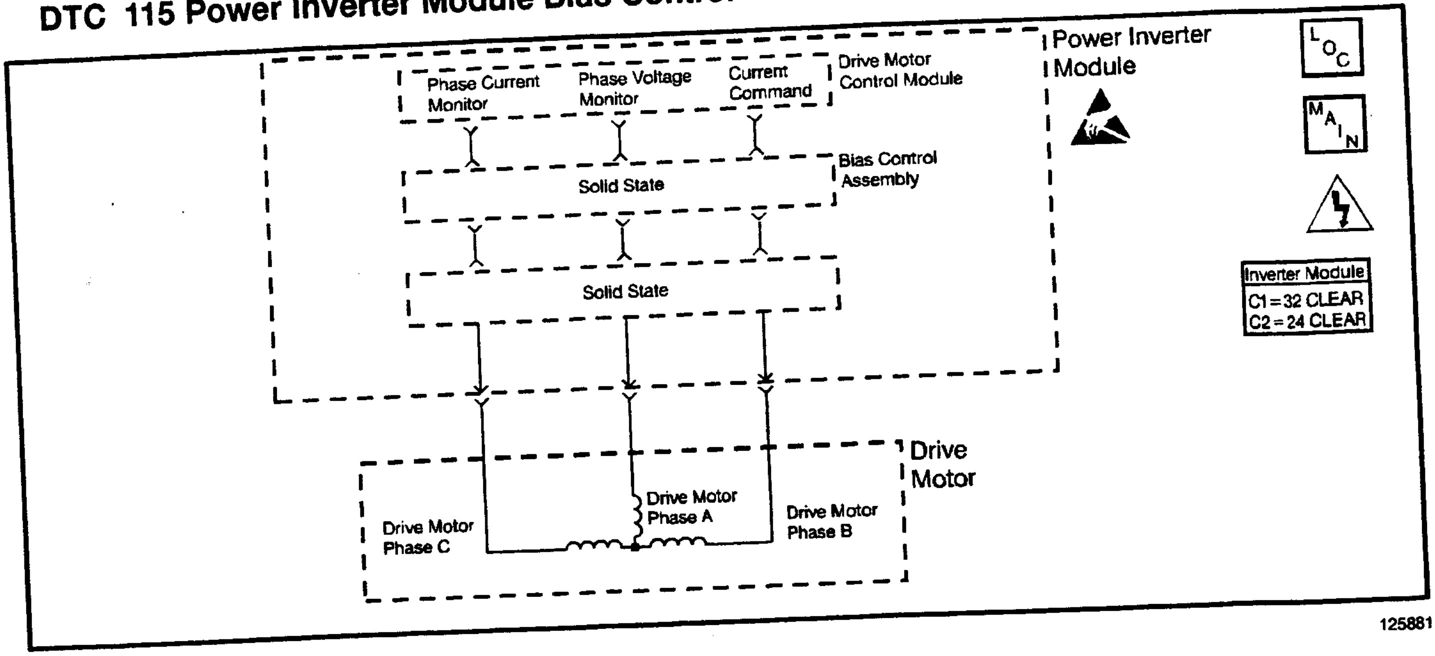
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current, this indicates a problem in the Power Inverter Module.

DTC 112 - Output Control 1 Performance

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool, check for current DTC 112. Is DTC 112 current?	—	Go to Step 3	See Diagnostic aids
3	Replace the Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures in this section. Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 115 Power Inverter Module Bias Control Phase Current Circuit High During Coast


Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Power Inverter Module
Bias Control Assembly
Solid State
Solid State
Drive Motor
Drive Motor Phase A
Drive Motor Phase B
Drive Motor Phase C
LOC
MAIN
Inverter Module
C1=32 CLEAR
C2=24 CLEAR
125881

Circuit Description

The Drive Motor Control Module will command regeneration to provide current for recharging the batteries. It will monitor the current going into the battery assembly to verify the battery assembly is receiving the requested current.

Conditions for Setting the DTC

- The actual current exceeds commanded current by 15%.

Action Taken When the DTC Sets

- The Drive Motor Control Module turns ON the SERVICE SOON light.
- the DTC is stored in failure records buffer.
- Regeneration is disabled.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

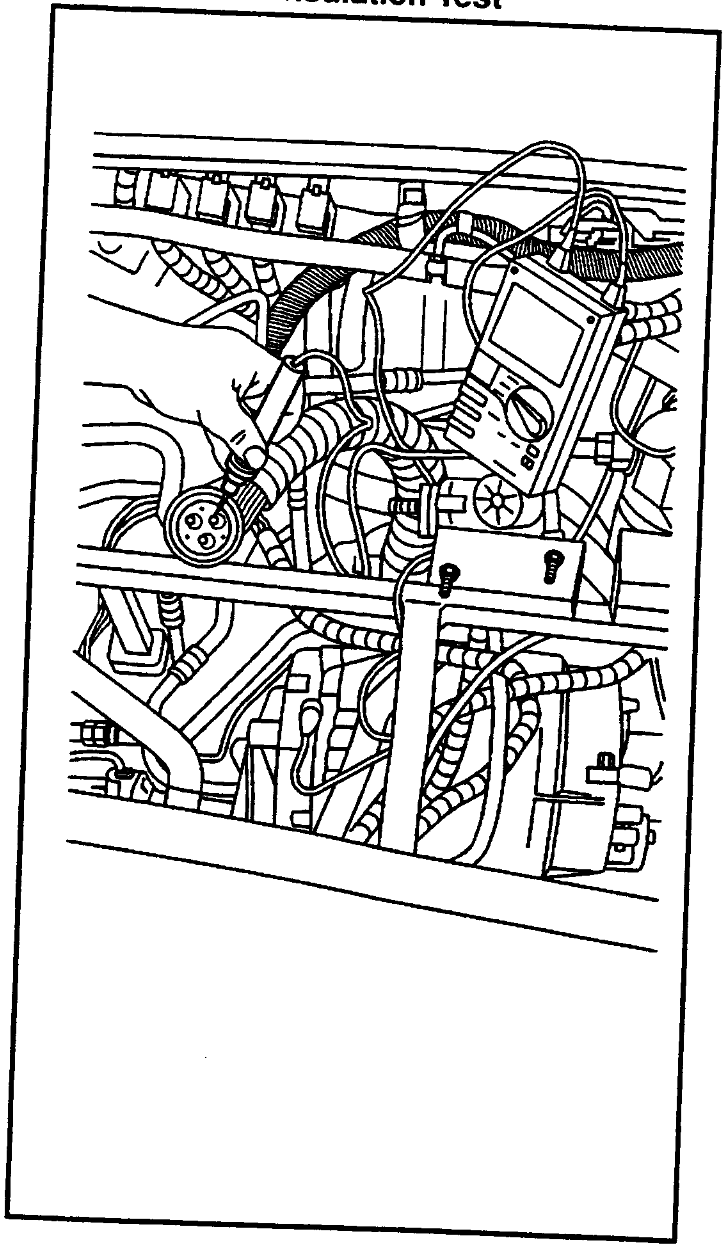
Diagnostic Aids

Check for the following conditions:

- Drive the vehicle, if the motor runs rough this may indicate an open or short in the phase motor winding.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Insulation Test



Test Description

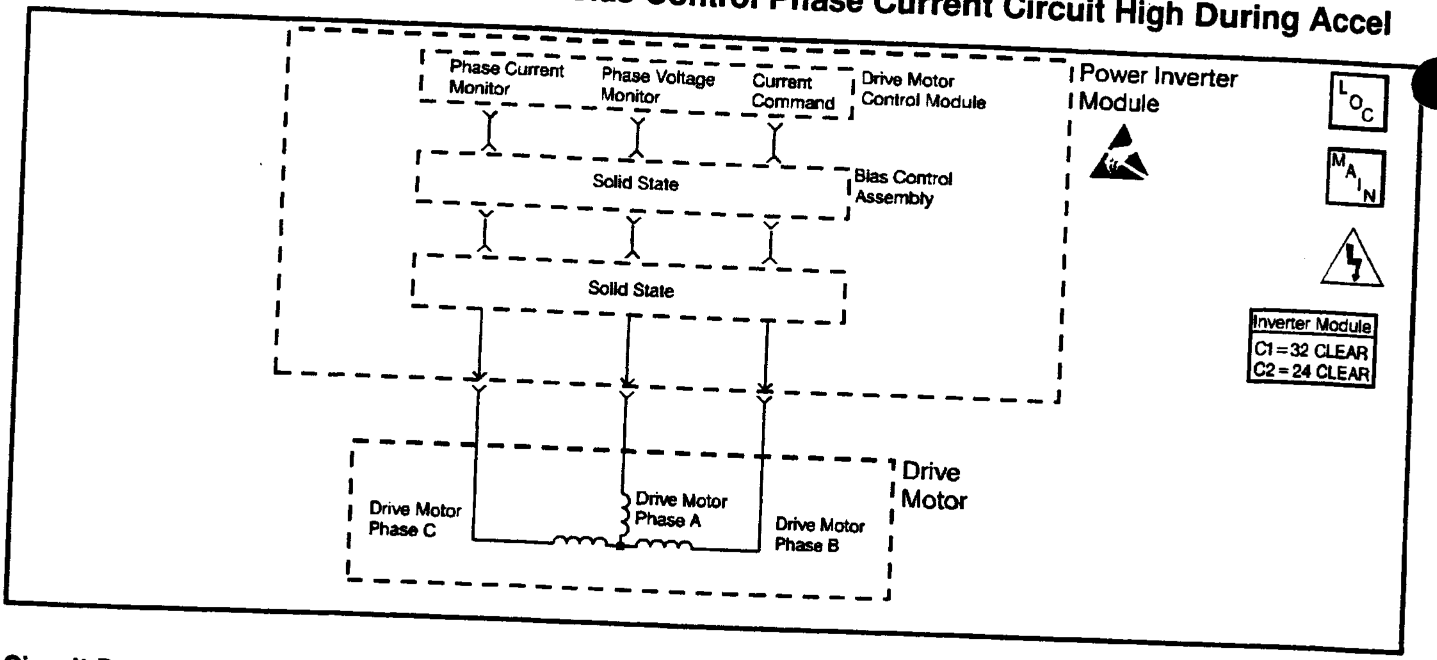
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step verifies that the fault is present.
3. This checks the phase windings for a loss to ground.
4. Checks for winding integrity.

DTC 115 Power Inverter Module Bias Control Phase Current Circuit High During Coast

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Capture failure records data. 2. Clear DTCs. 3. Drive Vehicle in the range described in failure records. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled*** 1. Perform the high voltage disable procedure. 2. Remove the Power Inverter Module to drive motor cannon connector at the Power Inverter Module. 3. Using the Digital Insulation Tester J 42502, Clip the black lead to the drive motor housing. 4. Switch the Insulation tester J 42502 to the 1000 volts position. 5. Check each phase for an short condition buy turning the tester ON and probing each pin on the drive motor one at a time. Did each drive motor winding phase read equal to or greater then the specified resistance?	5M ohms	Go to Step 4	Go to Step 5
4	1. Place the Digital Insulation Tester J 42502 in the continuity position. 2. Place the ground probe on phase 1 of the drive motor winding and touch the positive probe end to phases 2 and 3 and record readings. 3. Place the ground probe on phase 2 and touch phase 3 with the positive probe and record reading. Were the resistance readings within the specified range?	1.8 - 2.2 ohms	Go to Step 6	Go to Step 5
5	Replace the drive motor. Refer to *Drive Motor and Front Axles replacement*. Is the action complete?	—	Go to Step 7	—
6	Replace the Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 116 Power Inverter Module Bias Control Phase Current Circuit High During Accel


Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Power Inverter Module
LOC
MAIN
Solid State
Bias Control Assembly
Solid State
Inverter Module
C1=32 CLEAR
C2=24 CLEAR
Drive Motor
Drive Motor Phase C
Drive Motor Phase A
Drive Motor Phase B

125881

Circuit Description

The Drive Motor Control Module commands the required current based on the accelerator pedal input. The Bias Control Assembly supplies the required current and reports back to the Drive Motor Control Module the amount of current sent to the drive motor.

Conditions for Setting the DTC

- Feedback current exceeds commanded current by 15% or more during motoring.
- Propulsion is disabled.

Action Taken When the DTC Sets

- The Drive Motor Control Module commands the SERVICE NOW light ON.
- the DTC is stored in failure records buffer.
- Propulsion is disabled.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

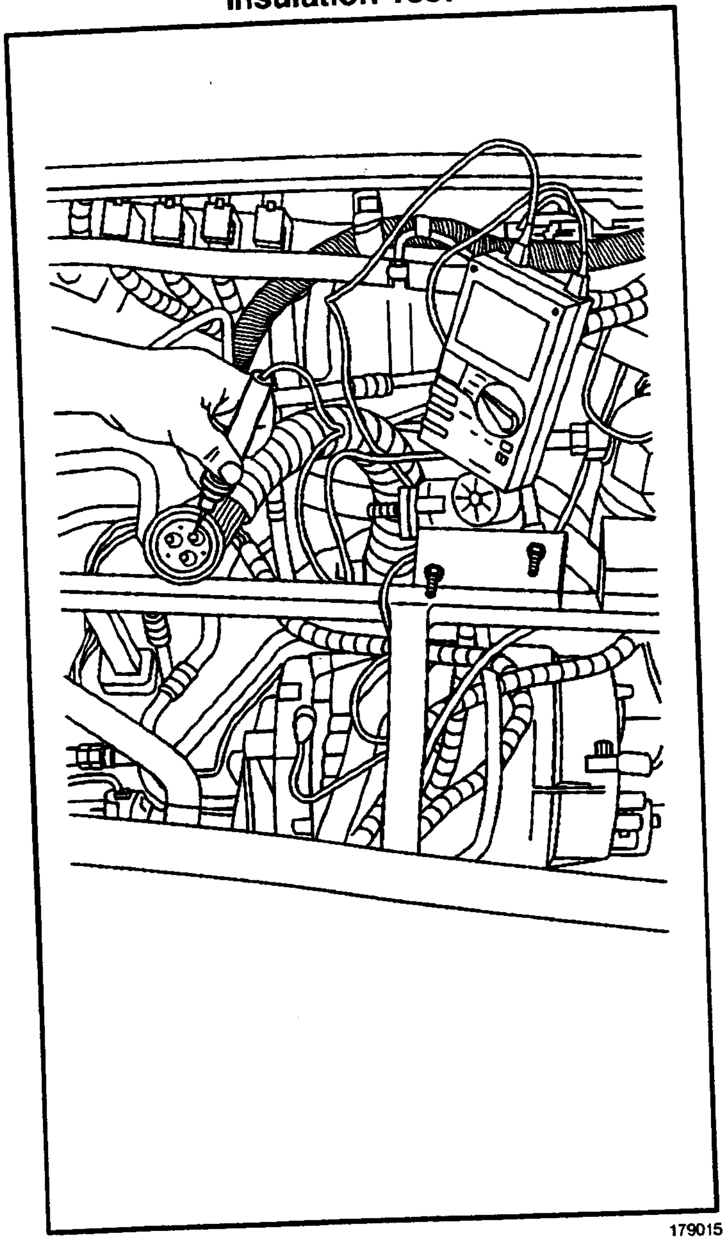
Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Insulation Test



Test Description

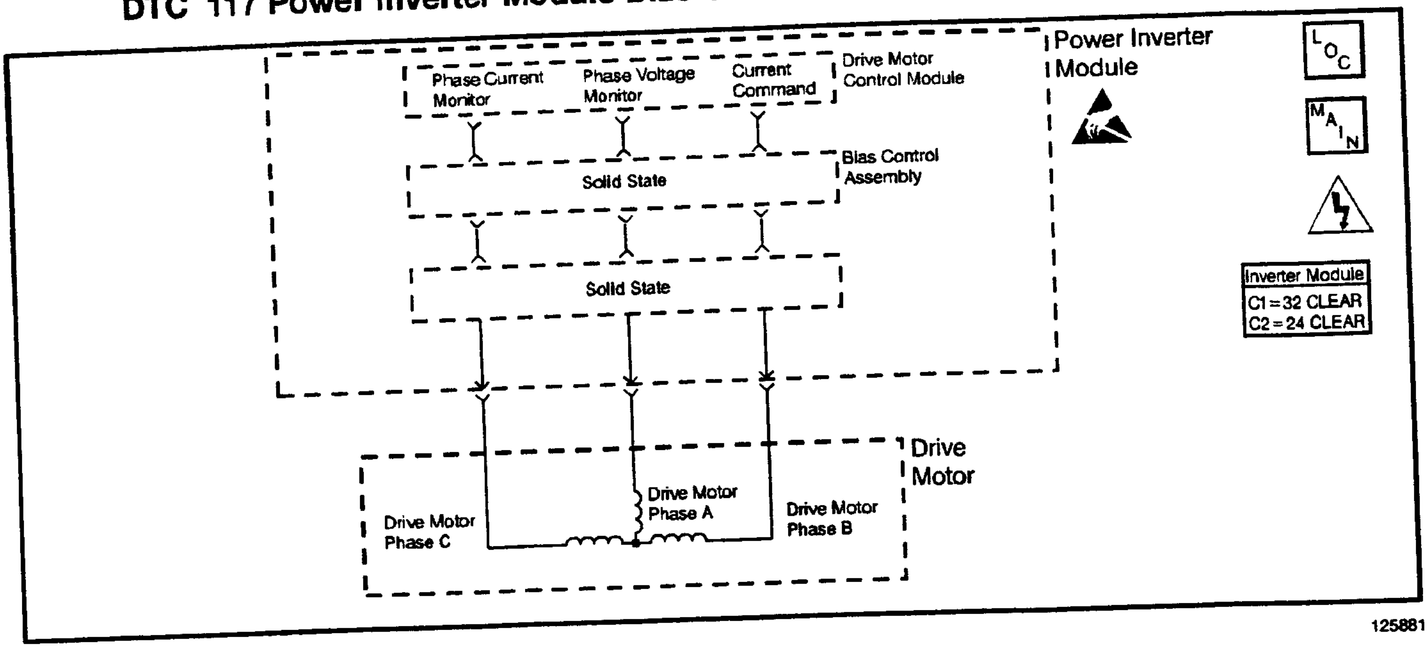
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current this indicates a problem in the Power Inverter Module.
3. This checks the phase windings for a loss to ground.
4. Checks for winding integrity.

DTC 116 - Drive Motor Power Inverter Module Bias Control Phase Current Circuit High During Accel

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Capture failure records data. 2. Clear DTCs. 3. Drive Vehicle in the range described in failure records. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled*** 1. Perform the high voltage disable procedure. 2. Remove the Power Inverter Module to drive motor cannon connector at the Power Inverter Module. 3. Using the Digital Insulation Tester J 42502, Clip the black lead to the drive motor housing. 4. Switch the Insulation tester J 42502 to the 1000 volts position. 5. On the drive motor harness side, check each phase for an short condition by turning the tester ON and probing each pin on the drive motor one at a time. Did each drive motor winding phase read equal to or greater then the specified resistance?	5M ohms	Go to Step 4	Go to Step 5
4	1. Place the Digital Insulation Tester J 42502 in the continuity position. 2. Place the ground probe on phase 1 of the drive motor winding and touch the positive probe end to phases 2 and 3 and record readings. 3. Place the ground probe on phase 2 and touch phase 3 with the positive probe and record reading. Were the resistance readings within the specified range?	1.8 - 2.2 ohms	Go to Step 6	Go to Step 5
5	Replace the drive motor. Refer to *Drive Motor and Front Axles replacement.* Is the action complete?	—	Go to Step 7	—
6	Replace the Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 117 Power Inverter Module Bias Control Phase Current Command Low


Power Inverter Module
Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Solid State
Bias Control Assembly
Solid State
Drive Motor
Drive Motor Phase A
Drive Motor Phase C
Drive Motor Phase B
LOC
MAIN
Inverter Module
C1=32 CLEAR
C2=24 CLEAR

125881

Circuit Description

The Drive Motor Control Module commands the required current based on the accelerator pedal input. The BCA supplies the required current and reports back to the Drive Motor Control Module the amount of current sent to the drive motor.

Conditions for Setting the DTC

- Phase current feedback is near zero.
- Drive Motor shaft speed is greater then 1000 RPM.

Action Taken When the DTC Sets

- The Drive Motor Control Module commands the SERVICE NOW light ON.
- the DTC is stored in failure records buffer.
- Propulsion is disabled.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

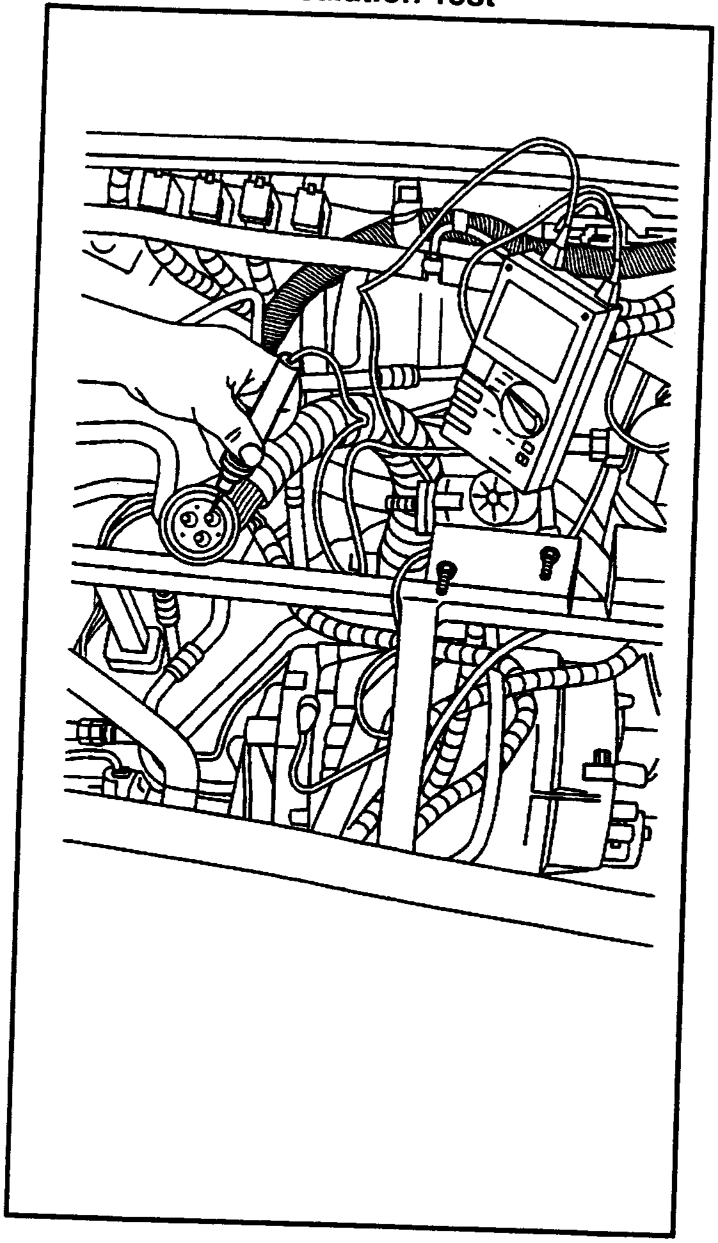
Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Insulation Test



179015

Test Description

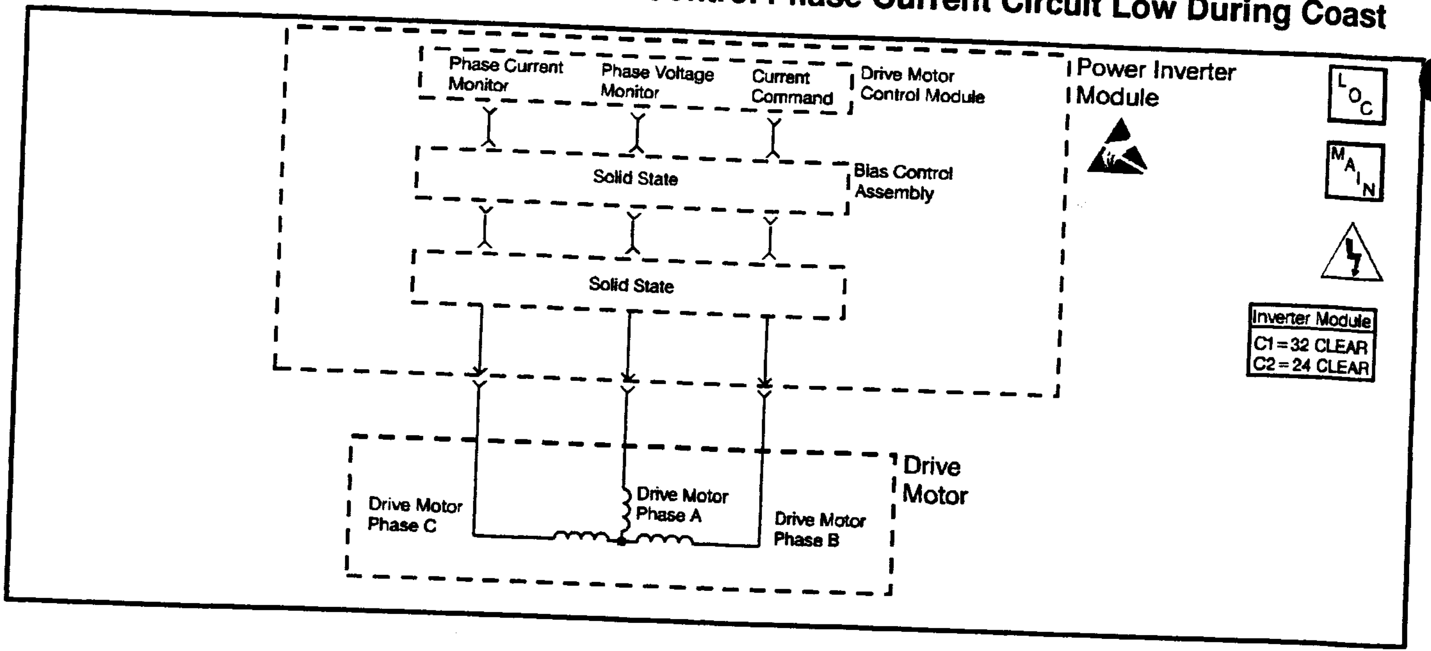
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current this indicates a problem in the Power Inverter Module.
3. This checks the phase windings for a loss to ground.
4. Checks for winding integrity.

DTC 117 Power Inverter Module Bias Control Phase Current Command Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Capture failure records data. 2. Clear DTCs. 3. Drive Vehicle in the range described in failure records. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled*** 1. Perform the high voltage disable procedure. 2. Remove the Power Inverter Module to drive motor cannon connector at the Power Inverter Module. 3. Using the Digital Insulation Tester J 42502, Clip the black lead to the drive motor housing. 4. Switch the Insulation tester J 42502 to the 1000 volts position. 5. Check each phase for an short condition buy turning the tester ON and probing each pin on the drive motor one at a time. Did each drive motor winding phase read equal to or greater then the specified resistance?	5M ohms	Go to Step 4	Go to Step 5
4	1. Place the Digital Insulation Tester J 42502 in the continuity position. 2. Place the ground probe on phase 1 of the drive motor winding and touch the positive probe end to phases 2 and 3 and record readings. 3. Place the ground probe on phase 2 and touch phase 3 with the positive probe and record reading. Were the resistance readings within the specified range?	1.8 - 2.2 ohms	Go to Step 6	Go to Step 5
5	Replace the drive motor. Refer to *Drive Motor and Front Axles replacement.* Is the action complete?	—	Go to Step 7	—
6	Replace the Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 118 Power Inverter Module Bias Control Phase Current Circuit Low During Coast


Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Power Inverter Module
LOC
MAIN
Solid State
Bias Control Assembly
Solid State
Inverter Module
C1=32 CLEAR
C2=24 CLEAR
Drive Motor
Drive Motor Phase C
Drive Motor Phase A
Drive Motor Phase B

125881

Circuit Description

The Drive Motor Control Module will command regeneration to provide current for recharging the batteries. It will monitor the current going into the battery assembly to verify the battery assembly is receiving the requested current.

Conditions for Setting the DTC

- The automatic disconnect is closed.
- The commanded signal has exceeded actual current during regeneration.
- Drive Motor shaft speed is greater then 1000 RPM.

Action Taken When the DTC Sets

- The Drive Motor Control Module turns ON the SERVICE SOON light
- the DTC is stored in failure records buffer
- Regeneration is disabled.

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

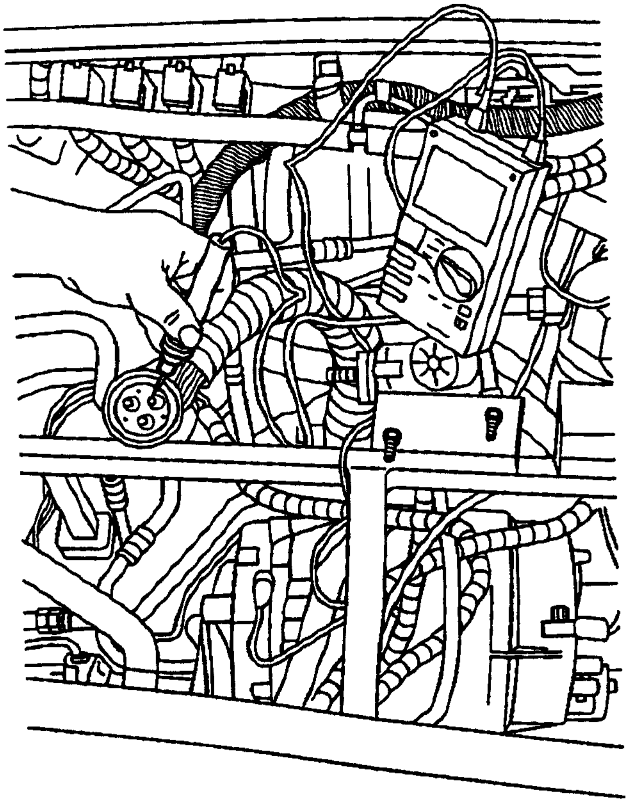
Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Insulation Test



179015

Test Description

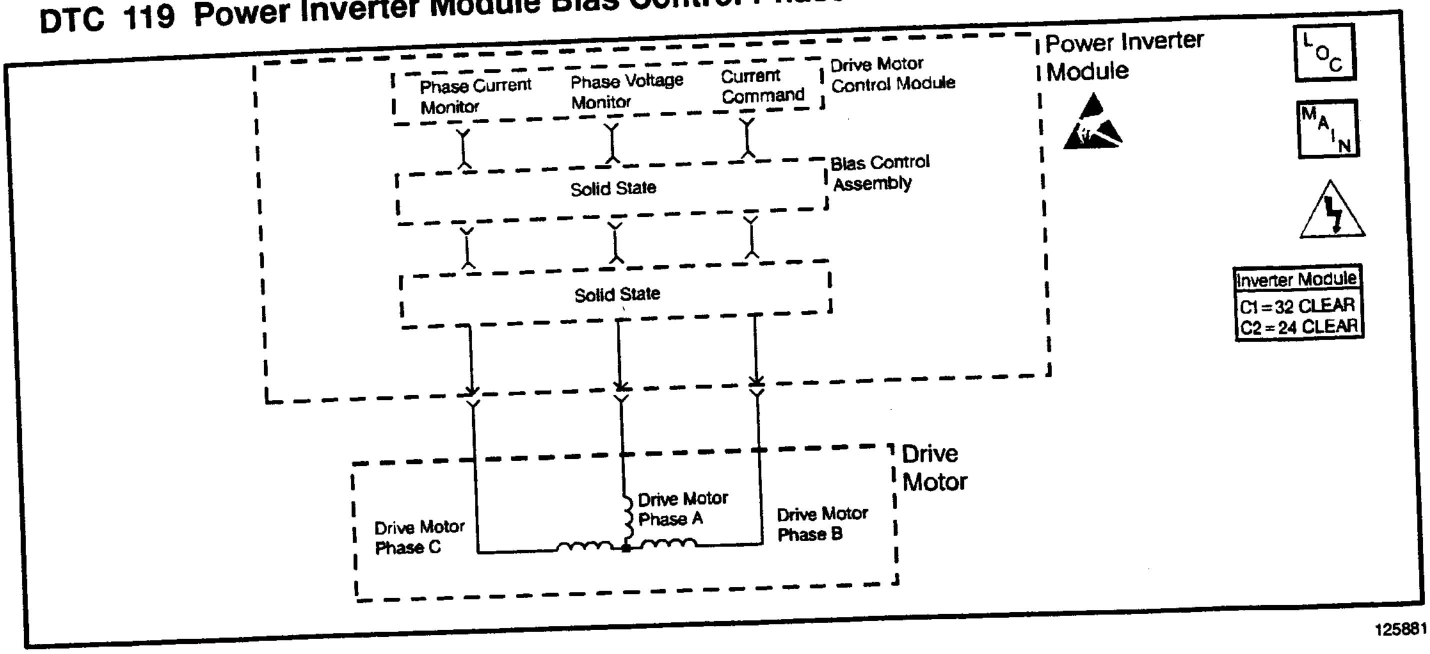
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks for phase voltage leakage to ground or an open in the windings.
3. This checks the phase windings for a loss to ground.
4. Checks for winding integrity.

DTC 118 Power Inverter Module Bias Control Phase Current Circuit Low During Coast

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Capture failure records data. 2. Clear DTCs. 3. Drive Vehicle in the range described in failure records. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and bums, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled*** 1. Perform the high voltage disable procedure. 2. Remove the Power Inverter Module to drive motor cannon connector at the Power Inverter Module. 3. Using the Digital Insulation Tester J 42502, Clip the black lead to the drive motor housing. 4. Switch the Insulation tester J 42502 to the 1000 volts position. 5. Check each phase for an short condition buy turning the tester ON and probing each pin on the drive motor one at a time. Did each drive motor winding phase read equal to or greater then the specified resistance?	5M ohms	Go to Step 4	Go to Step 5
4	1. Place the Digital Insulation Tester J 42502 in the continuity position. 2. Place the ground probe on phase 1 of the drive motor winding and touch the positive probe end to phases 2 and 3 and record readings. 3. Place the ground probe on phase 2 and touch phase 3 with the positive probe and record reading. Were the resistance readings within the specified range?	1.8 - 2.2 ohms	Go to Step 6	Go to Step 5
5	Replace the drive motor. Refer to *Drive Motor and Front Axles replacement.* Is the action complete?	—	Go to Step 7	—
6	Replace the Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 119 Power Inverter Module Bias Control Phase Current Circuit Low During Accel


Power Inverter Module
Phase Current Monitor
Phase Voltage Monitor
Current Command
Drive Motor Control Module
Solid State
Bias Control Assembly
Solid State
Drive Motor
Drive Motor Phase A
Drive Motor Phase B
Drive Motor Phase C
LOC
MAIN
Inverter Module
C1=32 CLEAR
C2=24 CLEAR

125881

Circuit Description

The Drive Motor Control Module commands the required current based on the accelerator pedal input. The BCA supplies the required current and reports back to the Drive Motor Control Module the amount of current sent to the drive motor.

Conditions for Setting the DTC

- Actual current is 15% lower than commanded.
- Drive Motor shaft speed is greater then 1000 rpm

Action Taken When the DTC Sets

- The Drive Motor Control Module turns ON the SERVICE SOON light
- the DTC is stored in failure records buffer

Conditions for Clearing the DTC

- The ignition must be cycled once after fault conditions are no longer present.
- DTC can be cleared by using the scan tool Clear Info function.

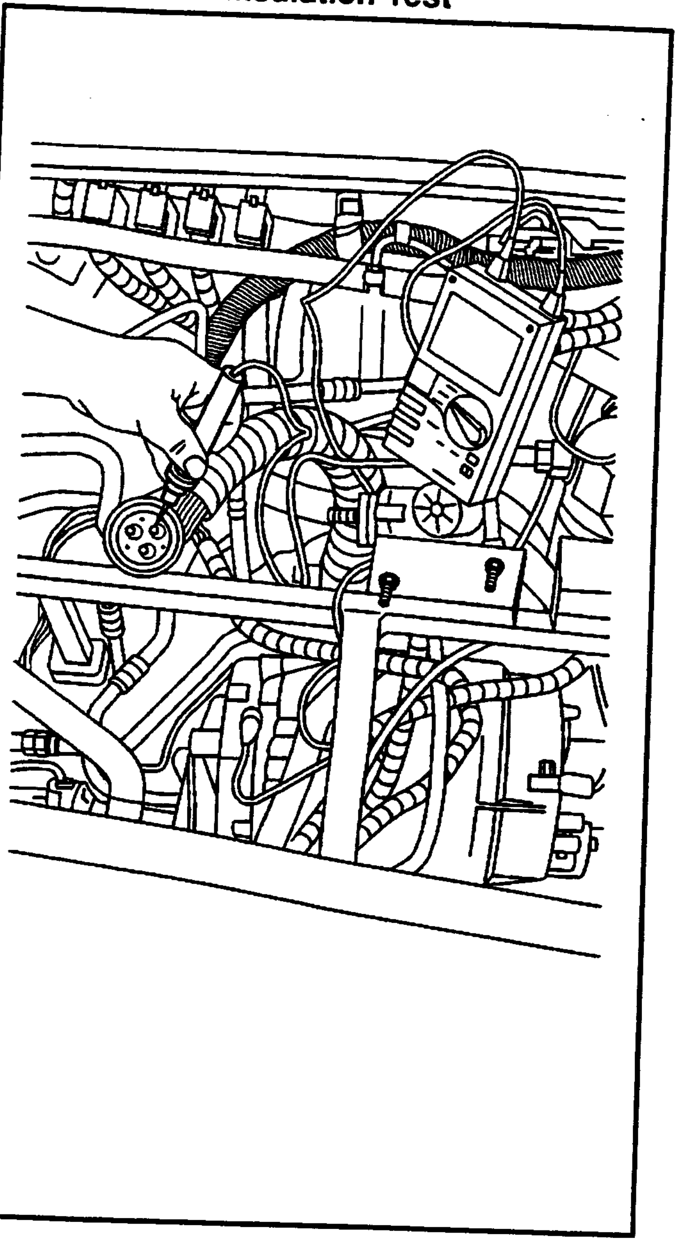
Diagnostic Aids

Check for the following conditions:

- If this DTC does not set in conjunction with Drive Motor Control Module DTC 115 or 116 replace the Power Inverter Module.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure Records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Insulation Test



Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. This step checks for phase voltage leakage to ground or an open in the windings.
3. This checks the phase windings for a loss to ground.
4. Checks for winding integrity.

DTC 119 Power Inverter Module Bias Control Phase Current Circuit Low During Accel

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Capture failure records data. 2. Clear DTCs. 3. Drive Vehicle in the range described in failure records. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled*** 1. Perform the high voltage disable procedure. 2. Remove the Power Inverter Module to drive motor cannon connector at the Power Inverter Module. 3. Using the Digital Insulation Tester J 42502, Clip the black lead to the drive motor housing. 4. Switch the Insulation tester J 42502 to the 1000 volts position. 5. Check each phase for an short condition buy turning the tester ON and probing each pin on the drive motor one at a time. Did each drive motor winding phase read equal to or greater then the specified resistance?	5M ohms	Go to Step 4	Go to Step 5
4	1. Place the Digital Insulation Tester J 42502 in the continuity position. 2. Place the ground probe on phase 1 of the drive motor winding and touch the positive probe end to phases 2 and 3 and record readings. 3. Place the ground probe on phase 2 and touch phase 3 with the positive probe and record reading. Were the resistance readings within the specified range?	1.8 - 2.2 ohms	Go to Step 6	Go to Step 5
5	Replace the drive motor. Refer to *Drive Motor and Front Axles replacement.* Is the action complete?	—	Go to Step 7	—
6	Replace the Power Inverter Module. Refer to Power Inverter Module replacement and programming procedures. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

Symptoms

Important Preliminary Checks

Checks	Action
Before Using This Section	Before using this section you should have performed the On-Board Diagnostic (OBD) System Check and determined that: 1. Both the Drive Motor and Battery Pack Control Modules as well as their related Malfunction Indicator Lamp(s) (MIL) are operating correctly. 2. There are no Diagnostic Trouble Codes (DTCs) stored, or there is a diagnostic code but no MIL. 3. Several of the following symptom procedures call for a careful visual/physical check. The importance of visual/physical checks cannot be over stressed, because they can lead to correcting a problem without further checks and can save valuable time.
Before Starting	• Check the both control modules grounds for being clean, tight, and in their proper locations. Refer to *Drive Motor Control Module or Battery Pack Control Module Wiring Diagrams.* • Check the wiring for proper connections, pinches, and cuts. Refer to *Wiring Diagrams.* • The following symptom tables contain groups of possible causes for each symptom. These procedures do not have to be done in consecutive order. If the scan tool readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely cause first. To determine if a specific vehicle is using a particular system or component, refer to the *Wiring Diagrams* for application.
Symptom	Verify the customer complaint, and locate the correct symptom in the table of contents. Check the items indicated under that symptom.

Intermittents

Checks	Action
DEFINITION: The problem may or may not turn ON the Malfunction Indicator Lamp(s) (MIL) or store a Diagnostic Trouble Code (DTC).	
Preliminary Checks	• Refer to *Important Preliminary Checks.* • **Do Not** use the DTC tables in this section for intermittent problems. The fault must be present to locate the problem. If a fault is intermittent, the use of DTC tables may result in the replacement of good parts.
Faulty Electrical Connections or Wiring	Faulty electrical connections or wiring can cause most intermittent problems. Perform a careful check of the suspected circuit for the following: • Poor mating of the connector halves, or terminals, not fully seated in the connector body (backed out). • Improperly formed or damaged terminals, carefully reform or replace all the connector terminals in the problem circuit to insure the proper contact tension. • Poor terminal to wire connection, this requires removing the terminal from the connector body to check. Refer to *Electrical Diagnosis.*
Road Test	If a visual/physical check does not locate the cause of the problem, drive the vehicle with a voltmeter connected to a suspected circuit or use a scan tool. If the wiring and connectors check OK, and a DTC was stored for a circuit having a sensor, replace the sensor.

Intermittents (continued)

Checks	Action
Intermittent Malfunction Indicator Lamp (MIL)	The following can cause an intermittent MIL and no DTCs: • Electrical system interference caused by a defective relay, Control Module driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operating. • The improper installation of electrical devices, such as lights, 2-way radios, electric motors, etc.. • The Malfunction Indicator Lamp (MIL) circuit or the diagnostic test terminal intermittently shorted to ground. • The Control Module grounds. Refer to *Component Locations*, .
Loss of DTC Memory	To check, disconnect the Accelerator Pedal Position (APP) sensor and turn the ignition to run. The Malfunction Indicator Lamp should come ON. A DTC should store and remain in memory when turning OFF the ignition for at least 10 seconds. If not, the Control Module may be faulty.

Lack Of Power

Checks	Action
DEFINITION: The Drive Motor delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	• Refer to *Important Preliminary Checks.* • Compare the customers vehicle with a similar unit. Make sure the customer has an actual problem.
Reduced Performance	Some fault conditions may place the vehicle in a reduced performance mode. In reduced performance mode the vehicle speed is limited by the Drive Motor Control Module to prevent further vehicle damage. A DTC should be present to identify this condition.
Additional Checks	• Check the Control Module grounds for being clean, tight, and in their proper location. • Check for dragging brakes. Refer to the appropriate service manual section. • Check Drive Motor Speed and Direction Sensor power and ground connections. • Check the Service Bulletins for updates.

Vehicle Will Not Charge

Checks	Action
DEFINITION: Battery Pack does not charge When the vehicle is connected to the Battery Pack charger.	
Preliminary Check	Refer to *Important Preliminary Checks.*
Inoperative Charger	• Insure that the charger is plugged in to a live power source. • Attempt to charge a different vehicle with the charger in question.
Busy Data Bus	Occasionally when attempting to charge the vehicle with the key ON and the vehicle powered-up, the Class II data bus will be two busy to allow the charger data to flow the Battery Pack Control Module. If the charger display reads CHECK VEHICLE: 1. Remove the charge paddle from the charge receptacle. 2. Place the charge paddle back in the charger. 3. Attempt to charge the vehicle again. If the procedure above does not allow the vehicle to charge it may be necessary to turn the ignition OFF before charging can occur.

Vehicle Will Not Charge (continued)

Checks	Action
Auxiliary Battery	Auxiliary battery power is required in order for the vehicle to charge. If the aux. battery does not have adequate voltage supply it may be necessary to charge the battery before the vehicle will charge or power-up. Also check the junction block for fusible links that may be open.
Additional Checks	• Check the Service Bulletins for updates. • Inspect charge receptacle for damage. • Try another charging station. • Try another vehicle on charge station.

Vehicle Will Not Power Up

Checks	Action
DEFINITION: Ignition switch in the run position. Vehicle electrical accessories working properly, no high voltage indicated, and no propulsion.	
Preliminary Checks	• Refer to *Important Preliminary Checks..* • Check the following: - Check the Run 2 relay and circuit for an open. - Check for 12 volts at the auxiliary battery. - Check for a faulty ignition switch. - Check for loose, missing, or damaged auxiliary battery cables or grounds. - Check for 12 volts at PIN 20 of the Inverter Module 32-way connector.
Additional Checks	• Check for any DTCs relating to the high voltage system. Refer to the appropriate service manual section. • Check the Service Bulletins for updates.

Vehicle Will Not Power Down

Checks	Action
DEFINITION: Ignition switch in the OFF position. All vehicle electrical accessories OFF. Auxiliary battery fully charged. No battery pack thermal activity. Vehicle wake-up is on for longer then 60 minutes.	
Preliminary Checks	• Refer to *Important Preliminary Checks* • Short to 12 volts on the vehicle wake-up circuit. • Check for a parasitic drain on the Aux battery.
Additional Checks	• Check for any DTCs relating to the high voltage system. Refer to the appropriate service manual section. • Check the Service Bulletins for updates.

Reduced Range

Checks	Action
DEFINITION: Vehicle range, as measured by an actual road test, is noticeably lower than expected. Also, the vehicle range is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test in similar temperature and driving conditions.	
Preliminary Checks	• Refer to *Important Preliminary Checks.* • Check owners driving habits: - Is the A/C ON full time (Defroster mode ON)? - Check the tires for being at the correct pressure? - Are exceedingly heavy loads being carried? - Are steep grades frequently being driven? - Is the acceleration too much, too often? • Check for alterations to the vehicle that may increase wind drag: - Provided tannoue cover not in use. - Addition of hood bug deflector. • Cold climate conditions increasing rolling resistance and decreasing battery temperature.
Additional Checks	• Check for the proper calibration of speedometer. • Check for dragging brakes. Refer to the appropriate service manual section. • Check the Service Bulletins for updates. • Refer to Battery Pack Control Module section for further information.

Repair Instructions

Drive Motor Control Module Reprogramming

Some vehicles allow reprogramming of the control module without removal from the vehicle. This provides a flexible and a cost-effective method of making changes in software and calibrations. Software Programming is done using a scan tool.

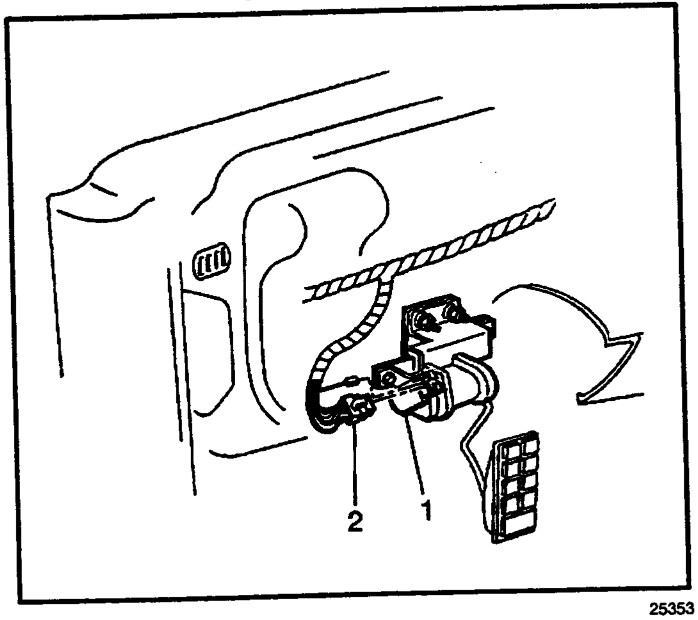
The Drive Motor Control Module is internal to the Power Inverter Module and is not accessible. After replacement of the Power Inverter Module the Drive Motor Control Module must be programmed.

The Service Programming System (SPS) will not allow incorrect software programming or incorrect calibration changes. For instruction and information on this procedure, Refer to the latest Techline information on re-programming or flashing procedures.

Accelerator Pedal Position Sensor

Remove or Disconnect

APP Sensor

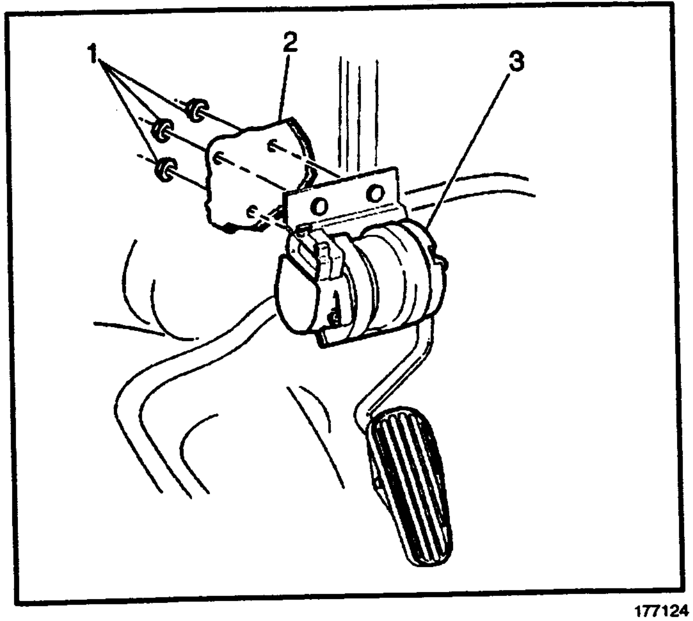


25353

Legend
1. APP Sensor
2. Harness Connector

1. Disconnect the Harness Connector from the sensor.

Remove Mounting Nuts



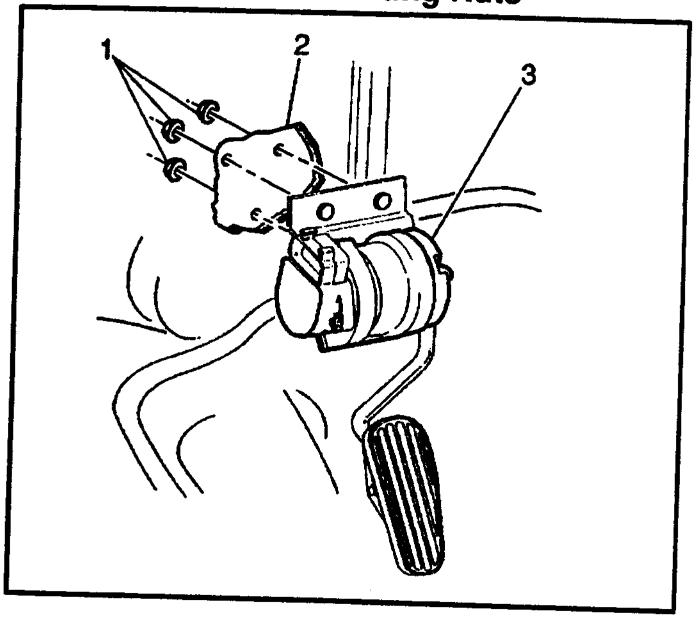
177124

Legend
1. Mounting nuts
2. Cowl
3. Accelerator pedal assembly

2. Remove the three mounting nuts from the cowl and discard.
3. Remove the accelerator pedal assembly.

Install or Connect

Install Mounting Nuts



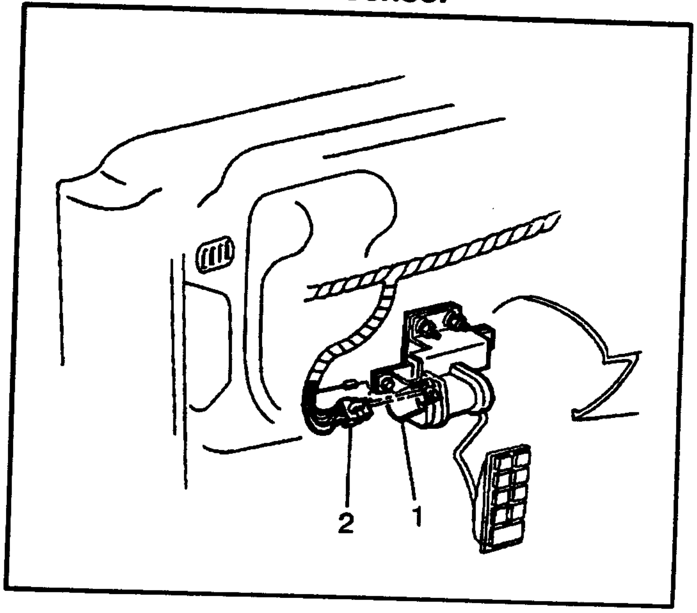
177124

Legend

1. Mounting nuts
2. Cowl
3. Accelerator pedal assembly

1. Install the three new mounting nuts from the cowl.
2. Tighten the accelerator pedal mounting nuts to 10 N•m (90 lb in).

APP Sensor



25353

Legend

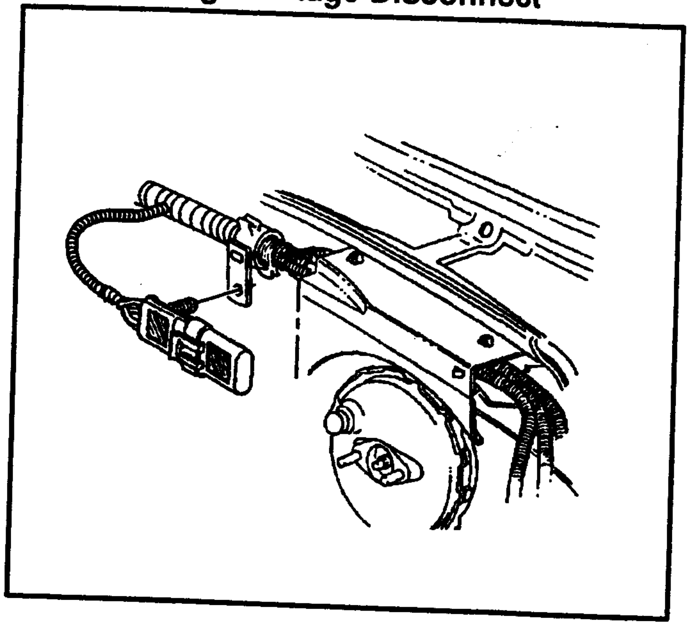
1. Accelerator Pedal Position Sensor
2. Harness Connector

3. Connect the harness connector to the sensor.

Power Inverter Module

Remove or Disconnect

High Voltage Disconnect

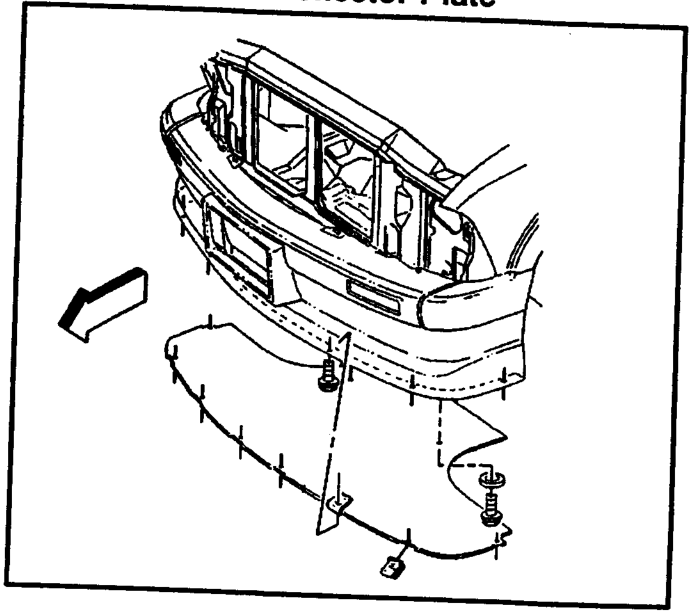


178492

Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled

1. Perform the high voltage disable procedure.

Air Deflector Plate

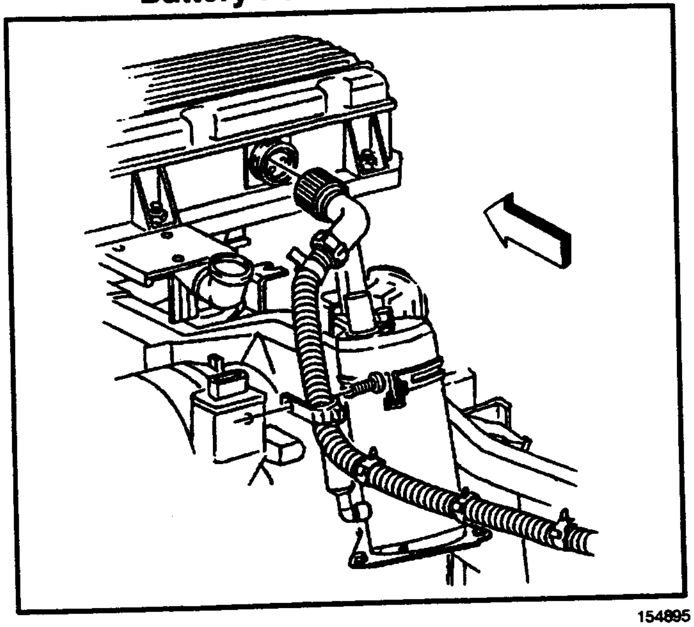


154882

2. Remove the air deflector panel.
3. Open the radiator drain cock.
4. Drain the coolant into a clean pan.
5. Close the radiator drain cock.
6. Remove the two hose straps securing coolant hose to the front of the Power Inverter Module.

7. Remove the two coolant hoses from the Power Inverter Module.

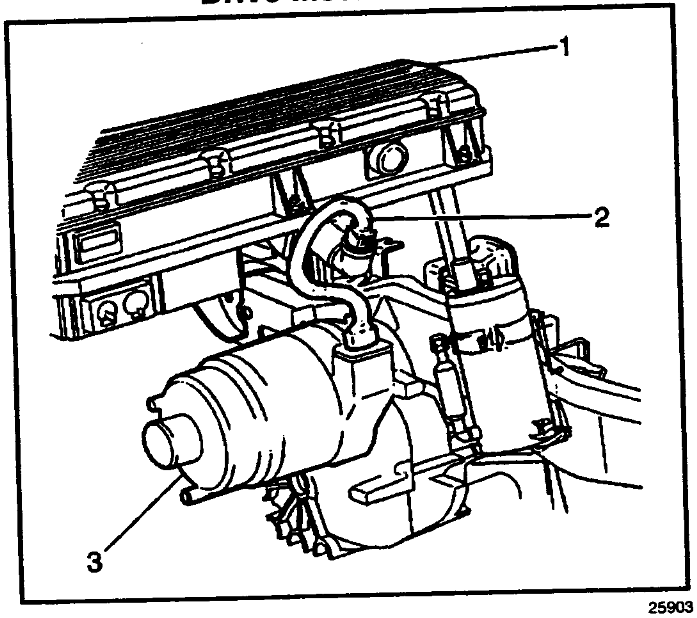
Battery Pack Power Cable



154895

8. Disconnect the Battery Pack Power Cable from the rear of the Power Inverter Module.
9. Install the canon connector cover J 42503 over the battery pack power cable.

Drive Motor Cable



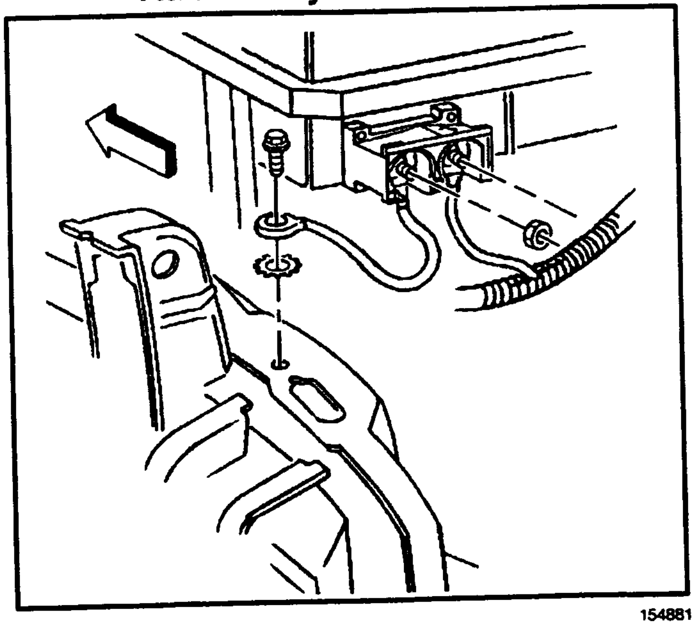
25903

Legend

1. Power Inverter Module
2. Drive Motor High Voltage Cable
3. Drive Motor

10. Disconnect the Drive Motor Cable from the rear of the Power Inverter Module.

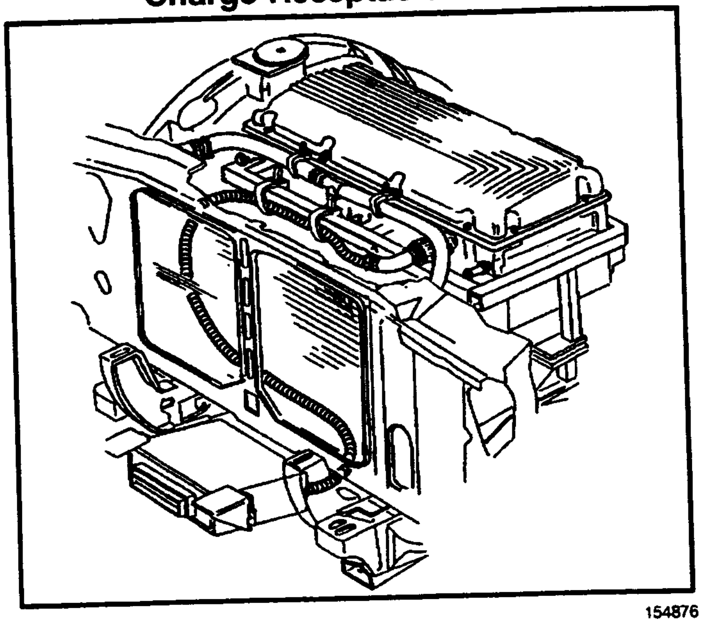
Aux Battery Cable at APM



154881

11. Disconnect the 12-volt battery cable from the rear of the Power Inverter Module.
12. Disconnect the ground cable from the rear of the Power Inverter Module.

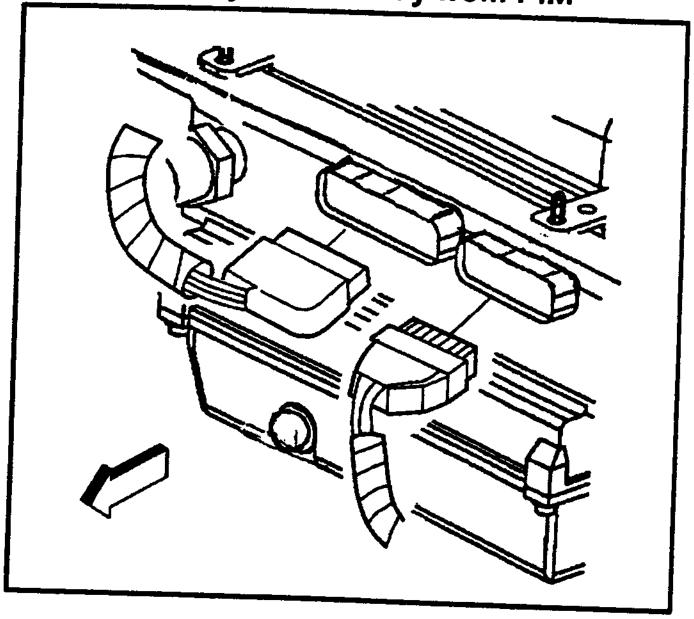
Charge Receptacle Cable



154876

13. Disconnect the charge receptacle cable from the front of the Power Inverter Module.

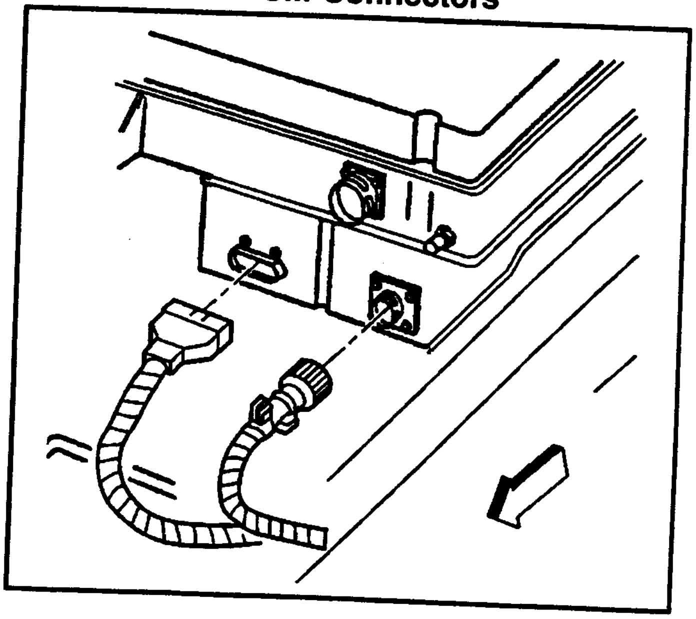
24-way and 32-way from PIM



69618

14. Disconnect the 24-way harness from the front of the Power Inverter Module.
15. Disconnect the 32-way harness from the front of the Power Inverter Module.

APCM Connectors



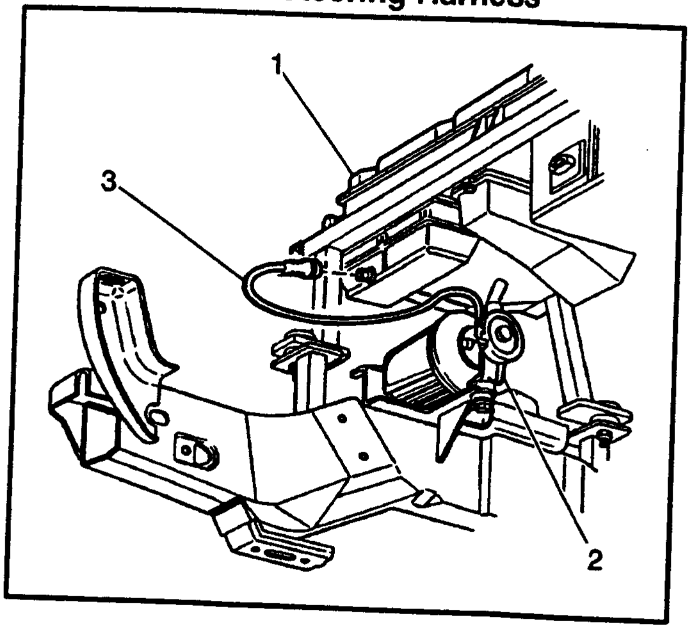
69634

16. Disconnect the 24-way harness from the front of the Accessory Power Control Module.

Important: When removing the Power Inverter Module, to prevent coolant intrusion into the Accessory Power Control Module, Power Steering Control Module connector and the AC Compressor connector, it is recommended that these connectors be covered and the Power Inverter Module coolant connections be plugged.

17. Disconnect the A/C compressor harness from the Accessory Power Control Module.

Power Steering Harness



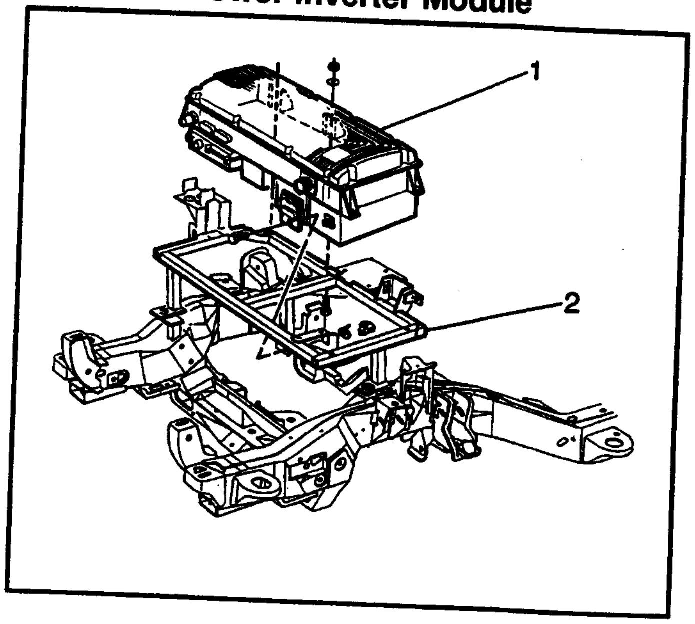
Legend

25950

1. Power Inverter Module
2. Power Steering Pump
3. Power Steering Cable

18. Disconnect the Power Steering harness from the Power Inverter Module.

Power Inverter Module



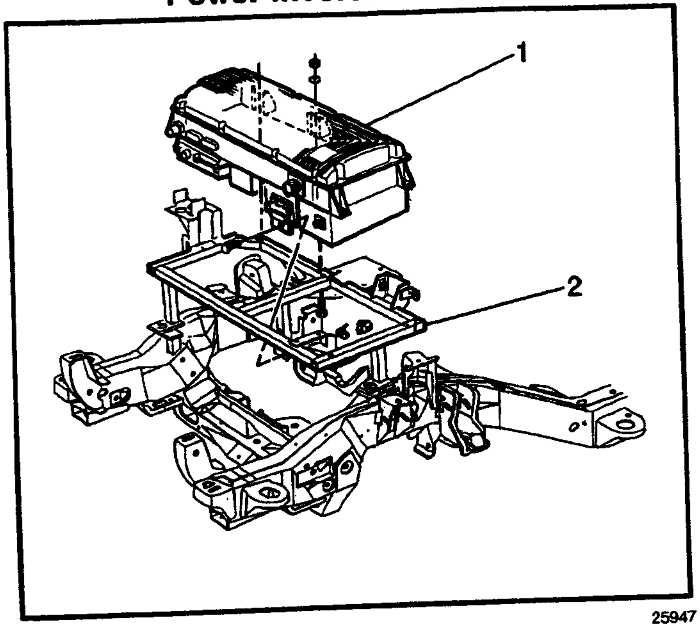
Legend

25947

1. Power Inverter Module
2. Power Inverter Module Subframe

19. Remove three bolts securing the Power Inverter Module to the subframe.
20. Remove mounting bolt from the bottom of the Power Inverter Module.

Power Inverter Module

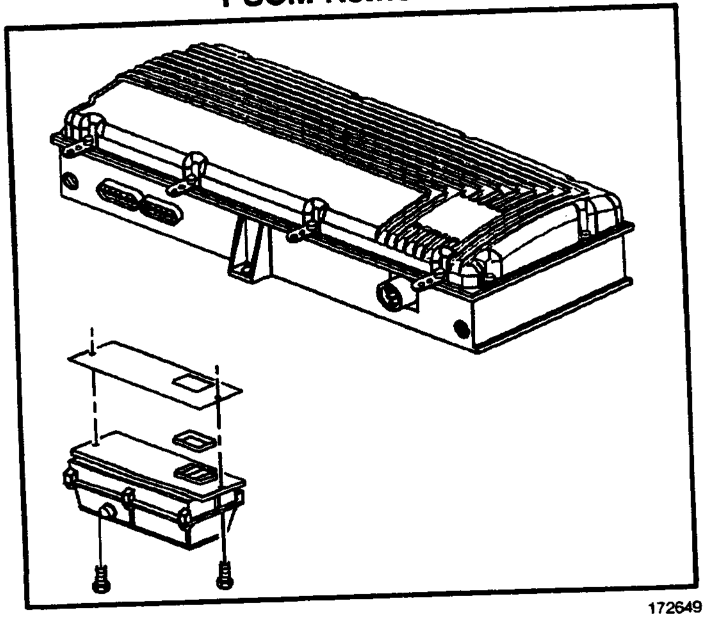


25947

Legend
1. Power Inverter Module
2. Power Inverter Module Subframe

21. Remove the Power Inverter Module by tilting the front up and removing towards the front of the vehicle.
22. Turn the Power Inverter Module upside down on a work bench.

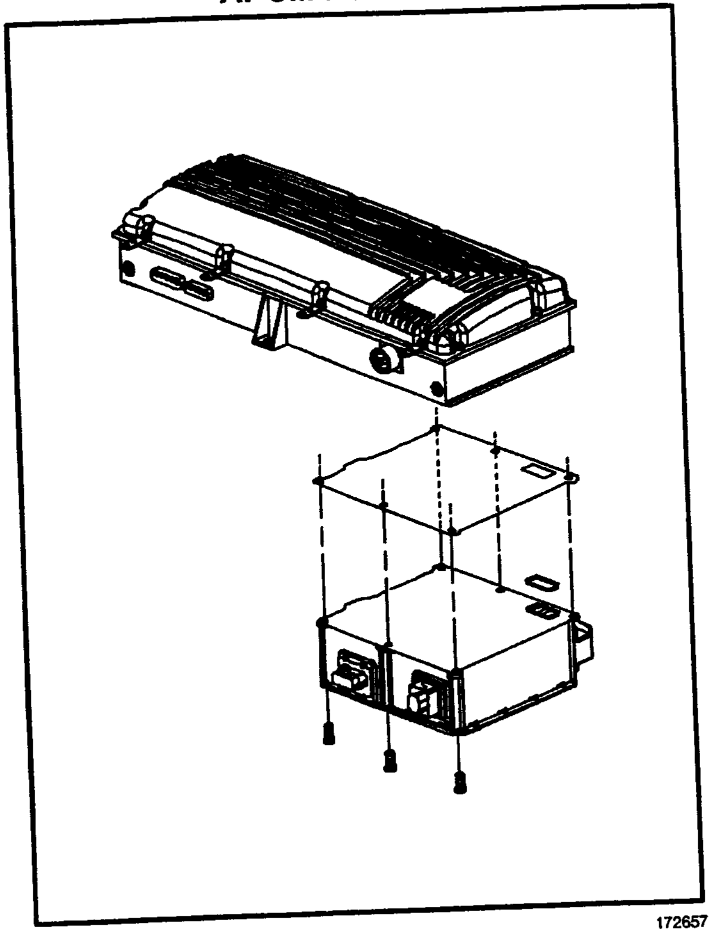
PSCM Removal



172649

23. Remove the two mounting screws, lockwashers, and washers from the power steering control module.
24. Remove the power steering control module from the Power Inverter Module.

APCM Removal

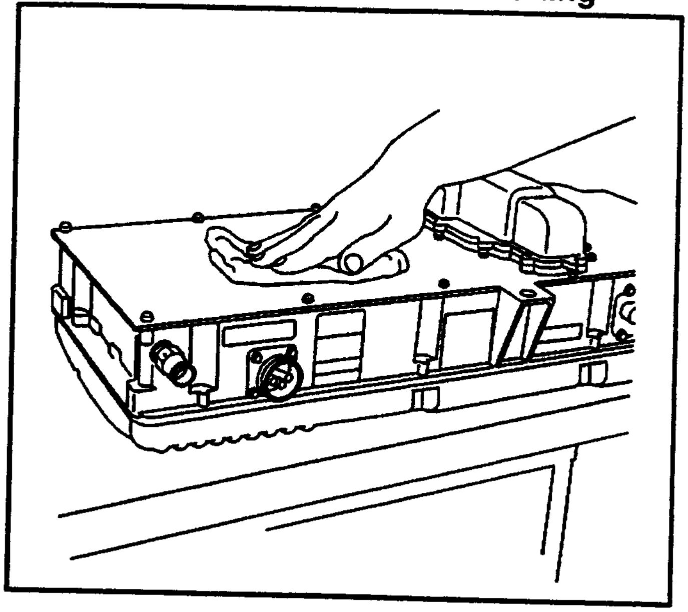


172657

25. Remove the six mounting screws, lockwashers, and washers from the accessory power control module.
26. Remove the accessory power control module from the Power Inverter Module.

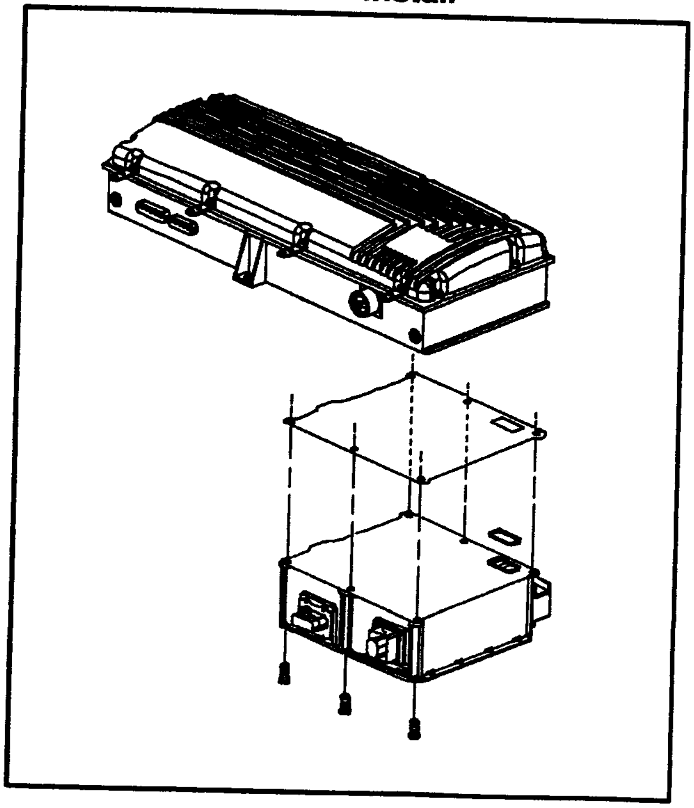
Install or Connect

Power Inverter Module Cleaning


179027

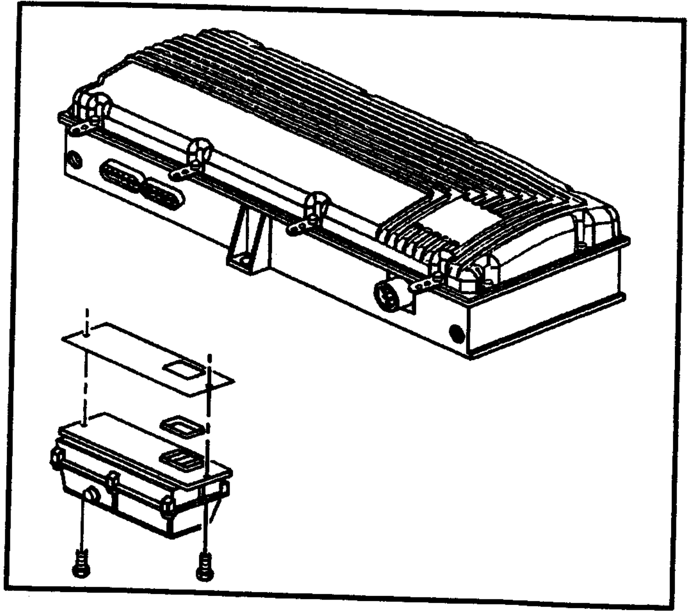
1. Clean the power steering control module mating surfaces with rubbing alcohol.
2. Clean the accessory power control module mating surfaces with rubbing alcohol.
3. Inspect all modules for bent or damaged pins and terminals.
4. Position the thermal gasket on the accessory power control module.

APCM Install


172657

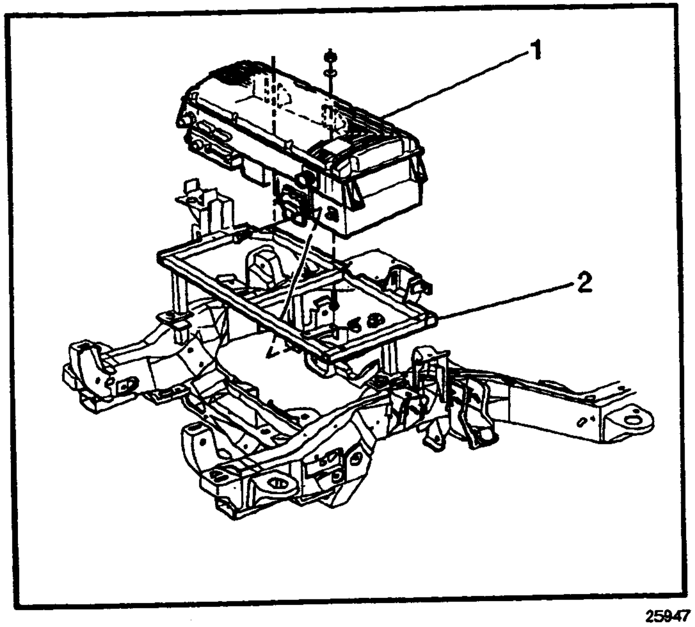
5. Install the accessory power control module with thermal gasket on the Power Inverter Module.
6. Install six mounting screws, lockwashers, and washers to the accessory power control module.
7. Tighten the accessory power control module mounting screws to 5.6 N•m (50 lb in). Refer to *Fastener Notice* in General Information.
8. Position the thermal gasket on the power steering control module.

PSCM Install


172649

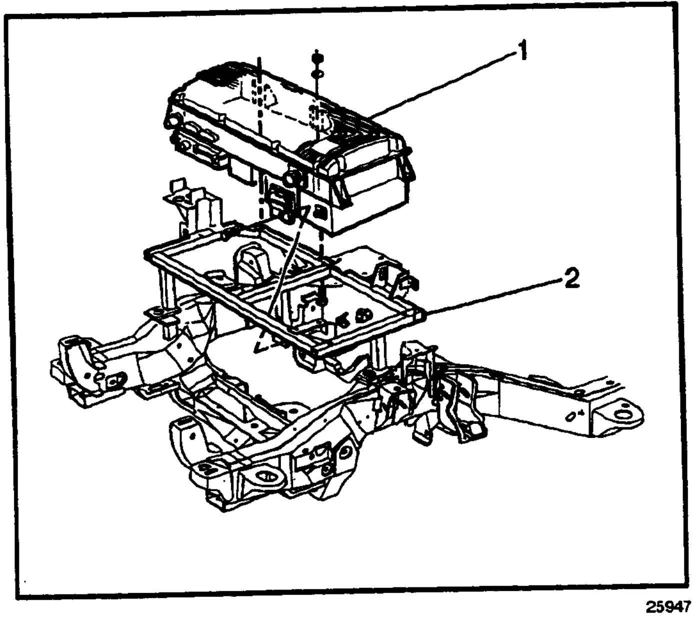
9. Install the power steering control module with thermal gasket on the Power Inverter Module.
10. Install the two mounting screws, lockwashers, and washers to the power steering control module.
11. Tighten the power steering control module mounting screws to 5.6 N•m (50 lb in). Refer to *Fastener Notice* in General Information.

Power Inverter Module



12. Position the Power Inverter Module on the subframe.

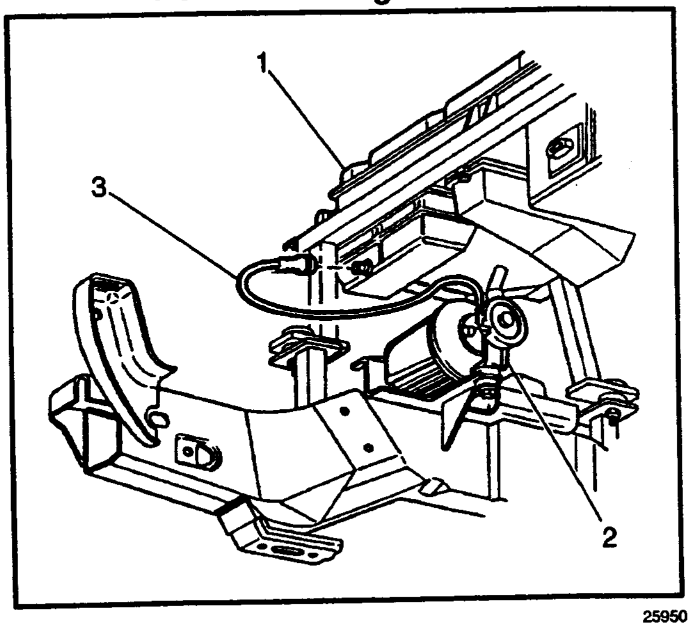
Power Inverter Module



Legend
1. Power Inverter Module
2. Power Inverter Module Subframe

13. Install the Power Inverter Module to subframe with three bolts.
14. Tighten bolts to 65 N•m (48 lb ft). Refer to *Fastener Notice* in General Information.
15. Install remaining mounting nut into the bottom of the Power Inverter Module.
16. Tighten nut to 32 N•m (24 lb ft). Refer to *Fastener Notice* in General Information.

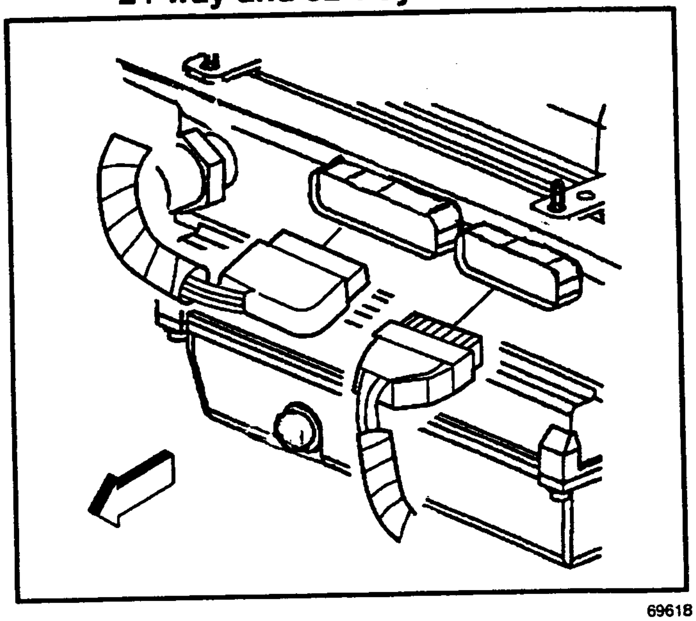
Power Steering Harness



Legend
1. Power Inverter Module
2. Power Steering Pump
3. Power Steering Cable

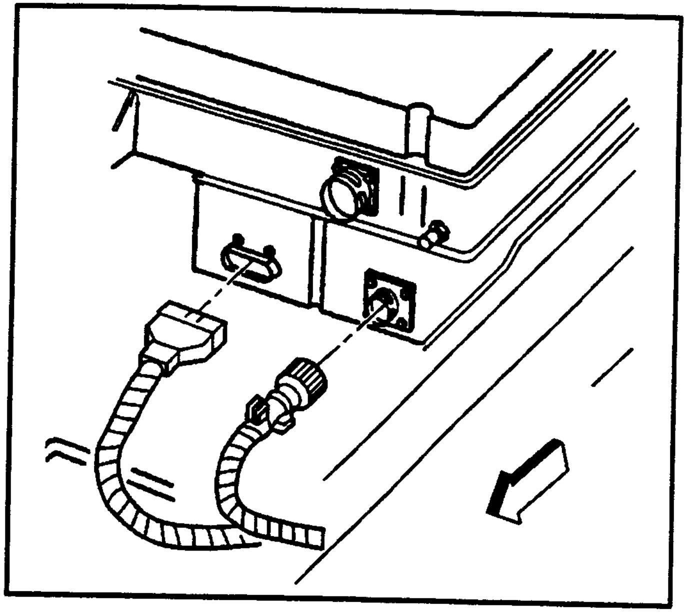
17. Connect the Power Steering harness to the Power Inverter Module.

24-way and 32-way from PIM



18. Connect the 32-way harness to the front of the Power Inverter Module.
19. Connect the 24-way harness to the front of the Power Inverter Module.

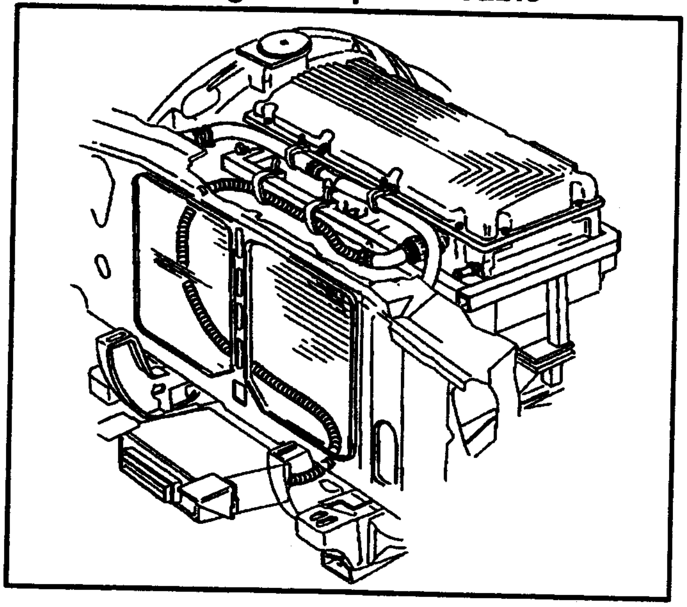
APCM Connectors



69634

20. Connect the 24-way harness from the front of the Accessory Power Control Module.
21. Connect the A/C compressor harness from the Accessory Power Control Module.

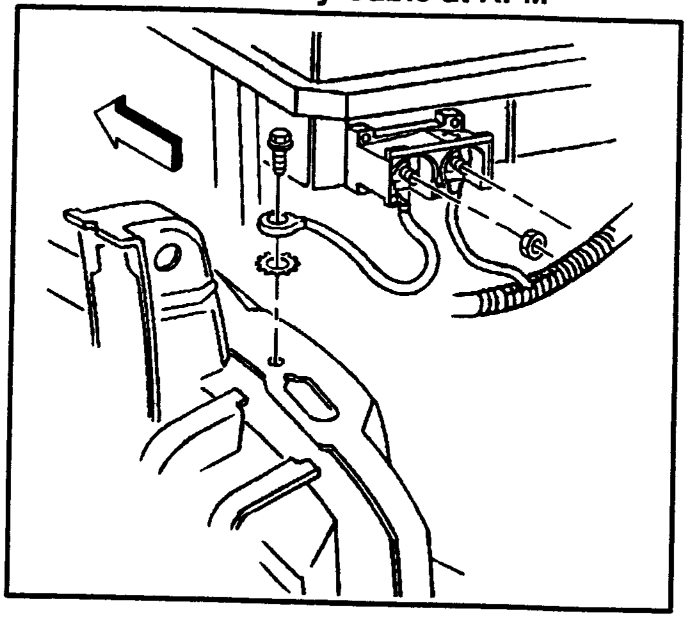
Charge Receptacle Cable



154876

22. Connect the charge port receptacle cable to the front of the Power Inverter Module.
23. Connect the ground cable to the rear of the Power Inverter Module.
24. Tighten nut to 18 N•m (13 lb ft). Refer to *Fastener Notice* in General Information.

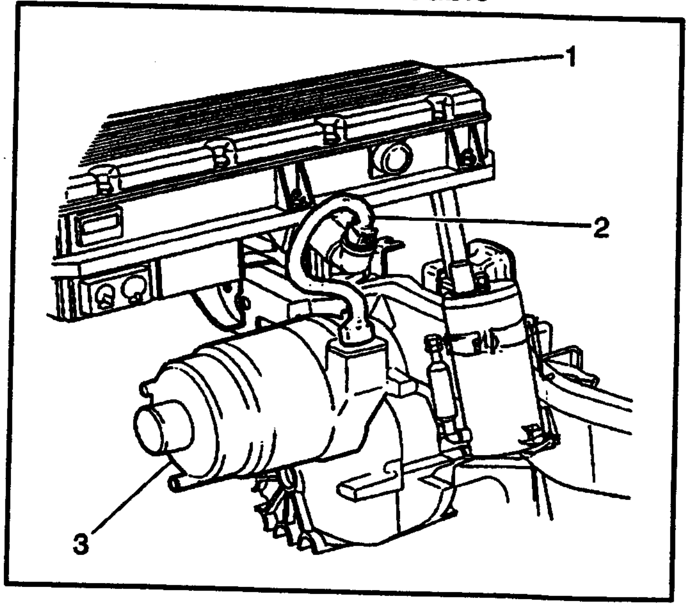
Aux Battery Cable at APM



154881

25. Connect the 12-volt battery cable to the rear of the APM.
26. Tighten nut to 18 N•m (13 lb ft). Refer to *Fastener Notice* in General Information.

Drive Motor Cable



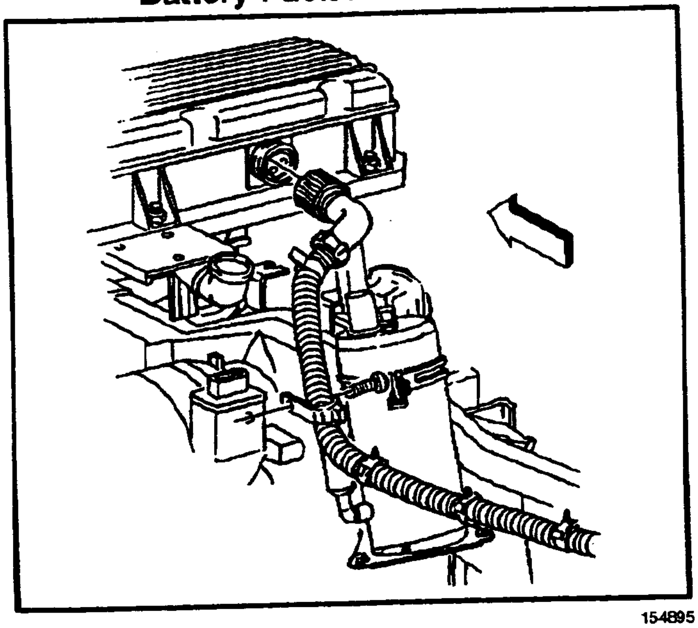
25903

Legend

1. Power Inverter Module
2. Drive Motor High Voltage Cable
3. Drive Motor

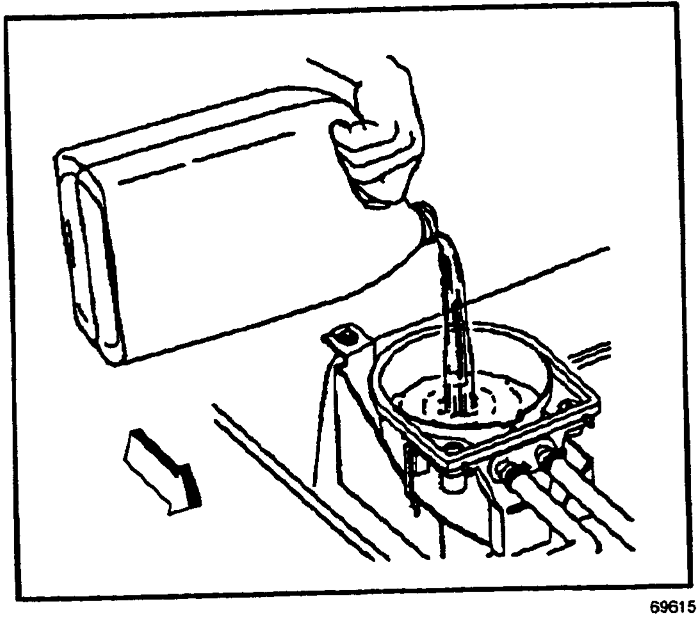
27. Connect the Drive Motor Cable to the rear of the Power Inverter Module.

Battery Pack Power Cable



28. Connect the Battery Pack Power Cable to the rear of the Power Inverter Module.
29. Connect two coolant hoses to the Power Inverter Module.

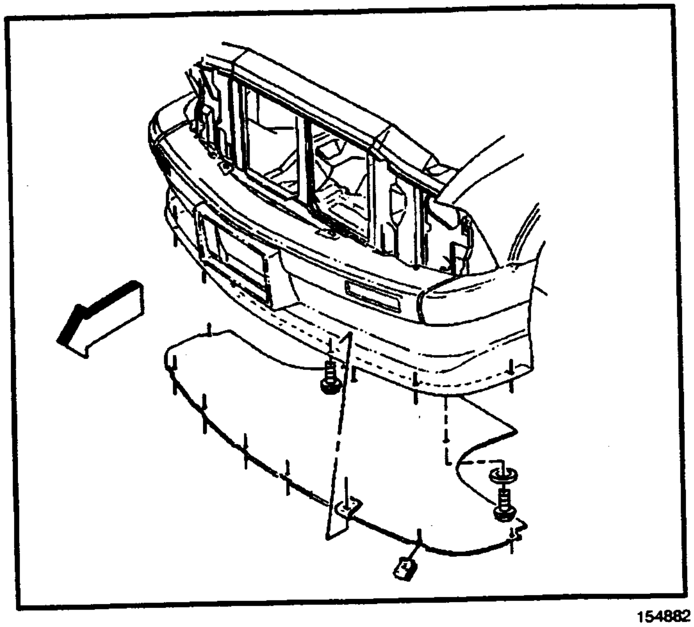
Refill Coolant



Notice: Use only Electracool coolant

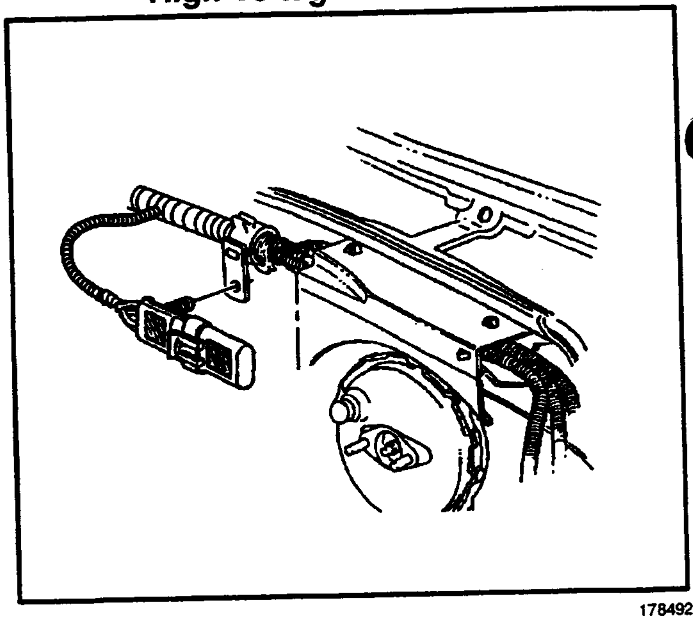
30. Refill the coolant system. Refer to *Coolant Fill Procedure* in *Cooling and Radiator.*

Air Deflector Plate



31. Install the air deflector panel.
32. Install the Fuel-Fired Heater Coolant Reservoir to its mounting bracket.

High Voltage Disconnect



33. Install the high voltage Disconnect.

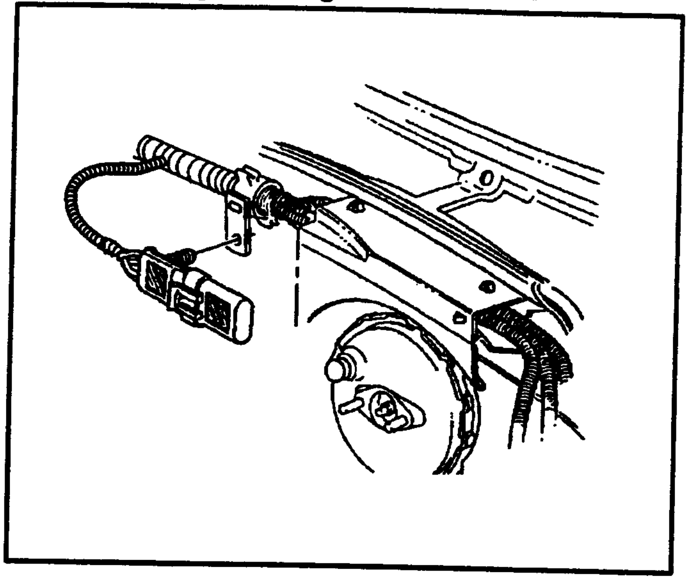
Note: The Drive Motor Control Module is internal to the Power Inverter Module and is not accessible. When replacing a Power Inverter Module the drive Motor Control Module must be programmed.

34. Program the Drive Motor Control Module using a scan tool. Refer to Drive Motor Control Module Reprogramming.

Accessory Power Control Module

Remove or Disconnect

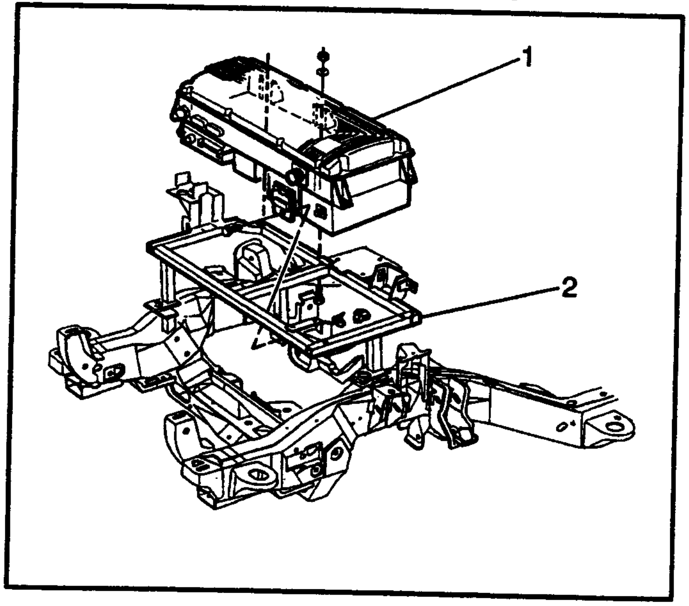
High Voltage Disconnect



178492

Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled

Power Inverter Module



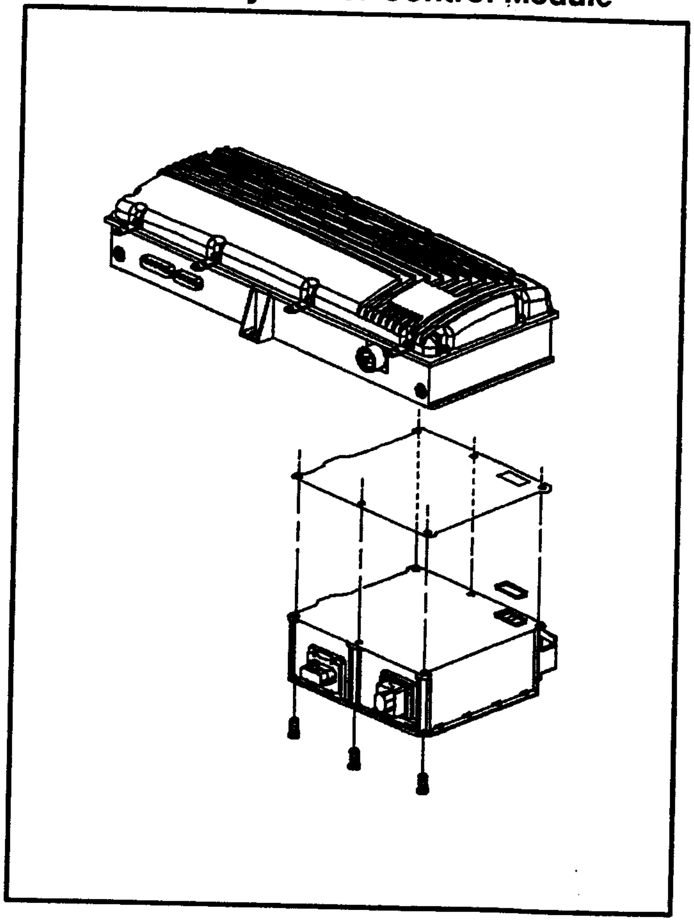
25947

Legend

1. Power Inverter Module
2. Power Inverter Module Subframe

1. Remove the Power Inverter Module. *Refer to Power Inverter Module Removal in this section.*
2. Turn the Power Inverter Module upside down on a work bench.

Accessory Power Control Module

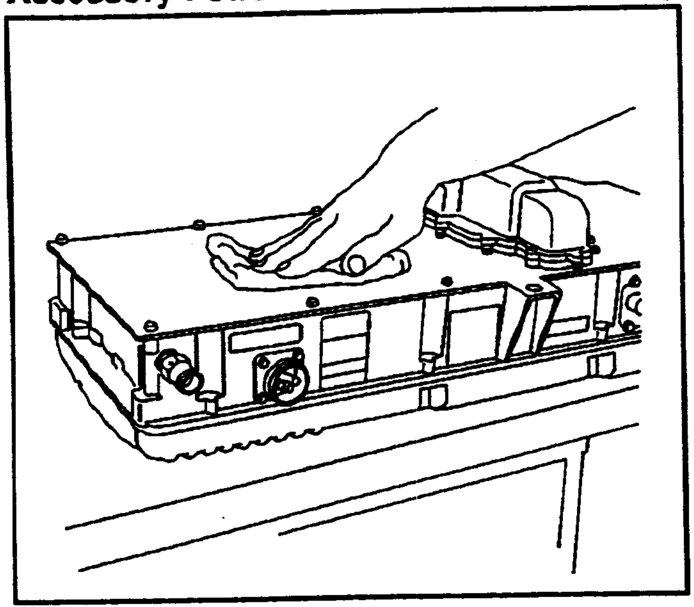


172657

3. Remove the six mounting screws, lockwashers, and washers from the accessory power control module.
4. Remove the accessory power control module from the Power Inverter Module.

Install or Connect

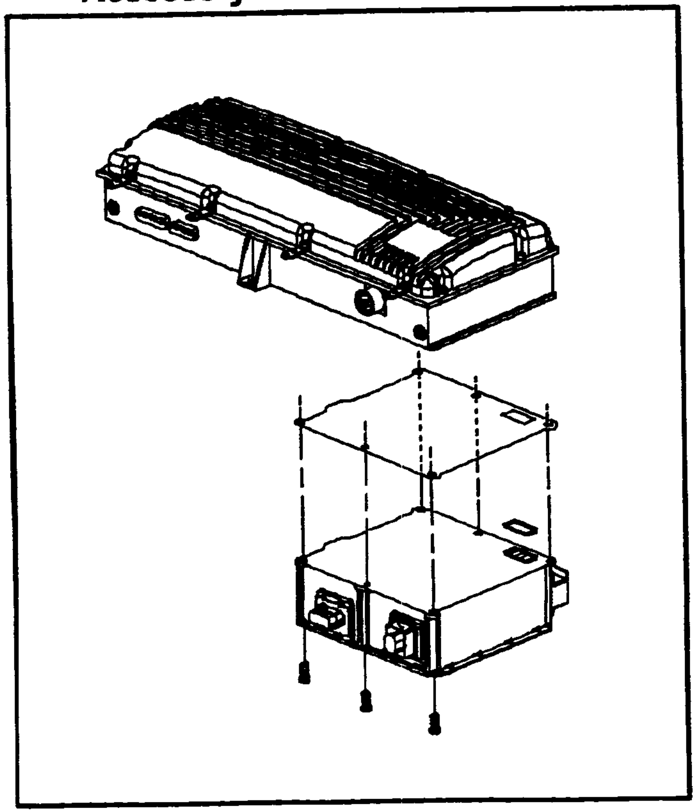
Accessory Power Control Module Cleaning



179027

1. Clean the accessory power control module mating surfaces with rubbing alcohol.
2. Inspect all modules for bent or damaged pins and terminals.
3. Position the thermal gasket on the accessory power control module.
4. Install the accessory power control module with thermal gasket on the Power Inverter Module.

Accessory Power Control Module



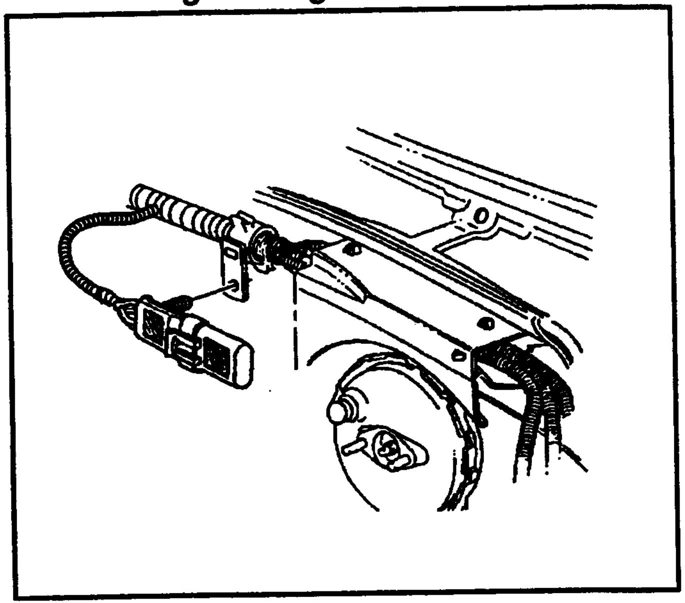
172657

5. Install six mounting screws, lockwashers, and washers to the accessory power control module.
6. Tighten the accessory power control module mounting screws to 5.6 N•m (50 lb in). Refer to *Fastener Notice* in General Information.
7. Reinstall the Power Inverter Module. *Refer to Power Inverter Module Replacement in this section.*
8. Reinstall the high voltage disconnect.

Power steering Control Module

Remove or Disconnect

High Voltage Disconnect

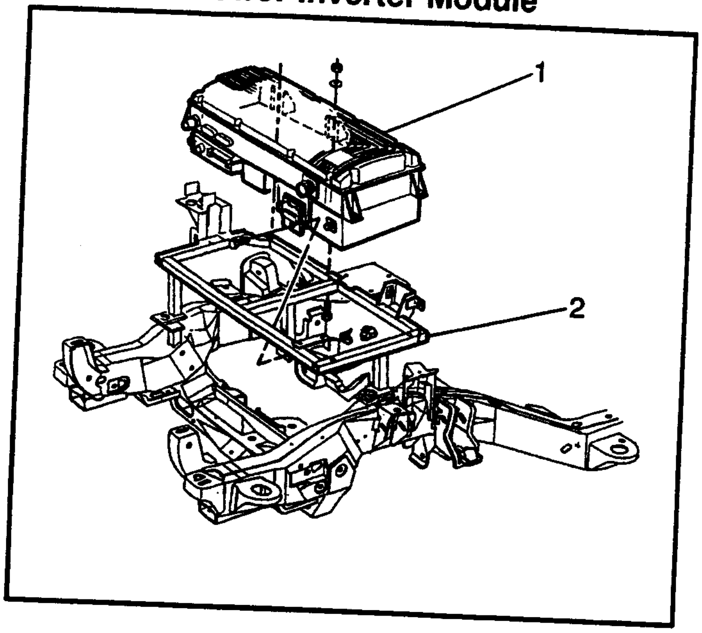


178492

Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled

1. Remove the high voltage disconnect.
2. Remove the Power Inverter Module. *Refer to Power Inverter Module Removal in this section.*
3. Turn the Power Inverter Module upside down on a work bench.

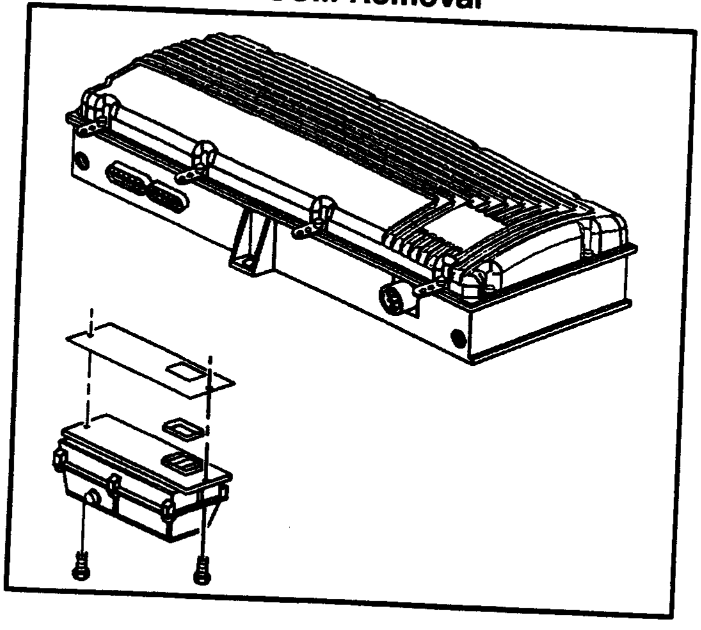
Power Inverter Module



25947

Legend
1. Power Inverter Module
2. Power Inverter Module Subframe

PSCM Removal

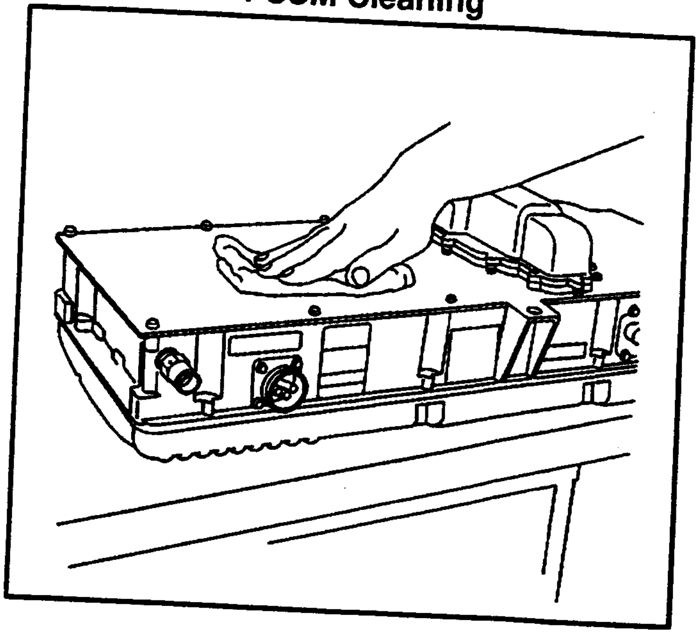


172649

4. Remove the two mounting screws, lockwashers, and washers from the power steering control module.
5. Remove the power steering control module from the Power Inverter Module.

Install or Connect

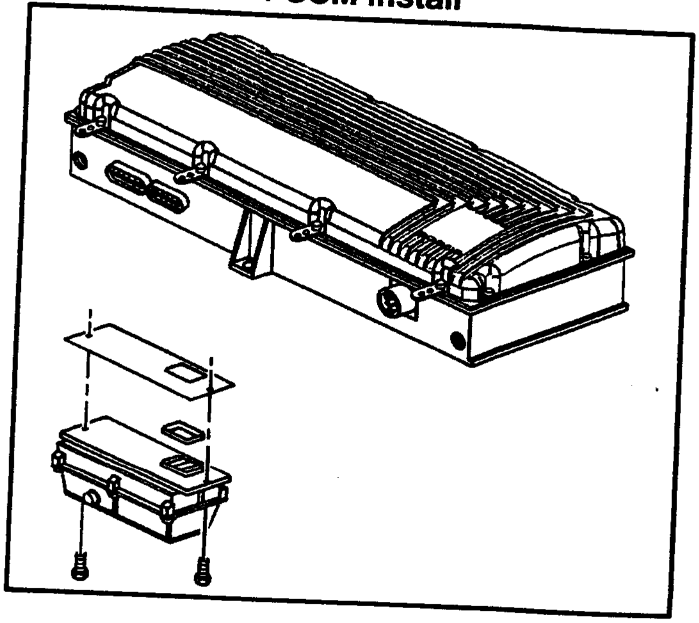
PSCM Cleaning



179027

1. Clean the accessory power control module mating surfaces with rubbing alcohol.
2. Inspect all modules for bent or damaged pins and terminals.
3. Position the thermal gasket on the power steering control module.
4. Install the power steering control module with thermal gasket on the Power Inverter Module.

PSCM Install



172649

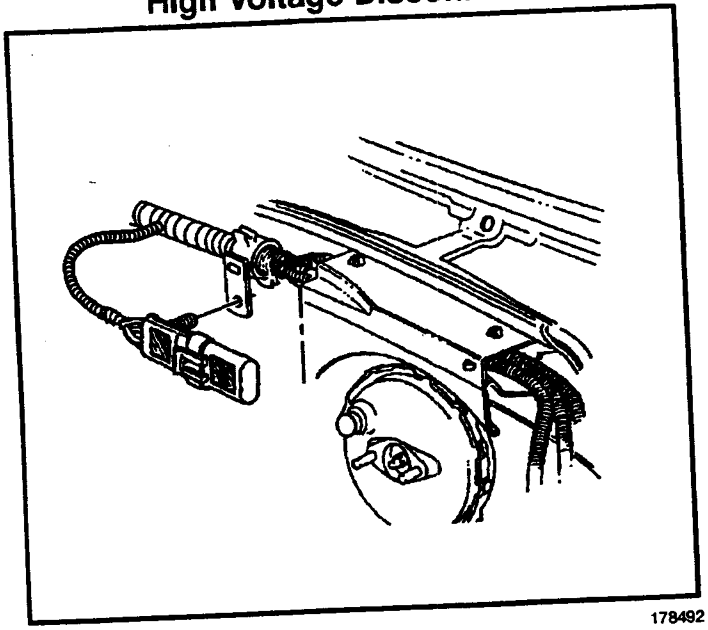
5. Install the two mounting screws, lockwashers, and washers to the power steering control module.
6. Tighten the power steering control module mounting screws to 5.6 N•m (50 lb in). Refer to *Fastener Notice* in General Information.

7. Reinstall the Power Inverter Module. *Refer to Power Inverter Module Replacement in this section.*
8. Reinstall the high voltage disconnect.

Charge Receptacle Assembly

Remove or Disconnect

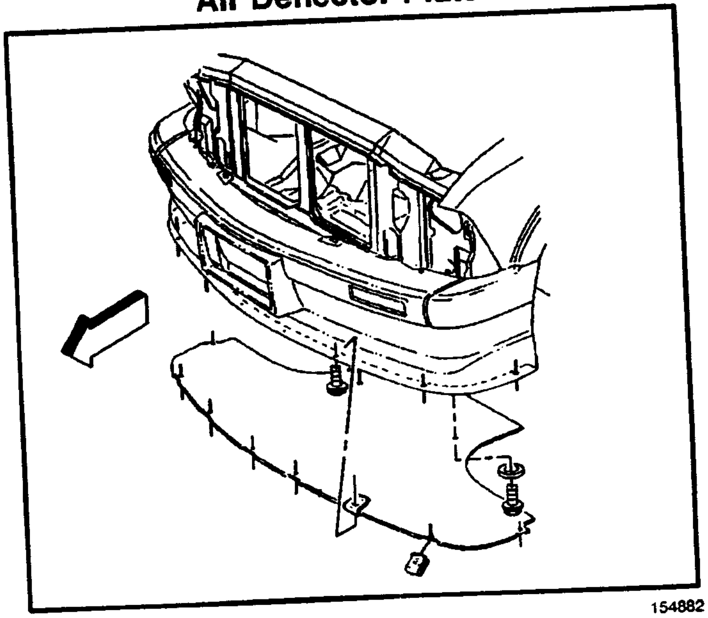
High Voltage Disconnect



178492

Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled

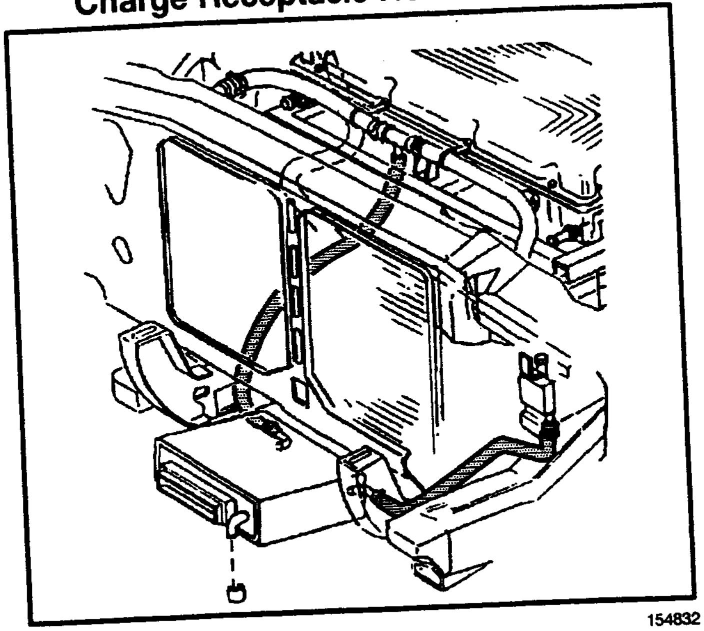
Air Deflector Plate



154882

1. Remove the air deflector panel.
2. Open the radiator drain cock.
3. Drain coolant into a clean pan.
4. Close the radiator drain cock.

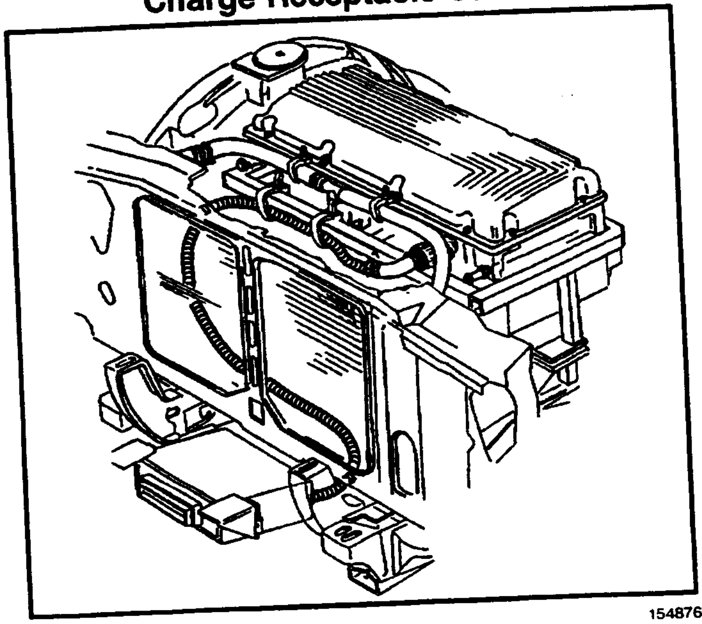
Charge Receptacle Hose Removal



154832

5. Remove the two coolant hoses from the charge receptacle.
6. Disconnect the 8 way electrical connector at the charge receptacle.

Charge Receptacle Cable

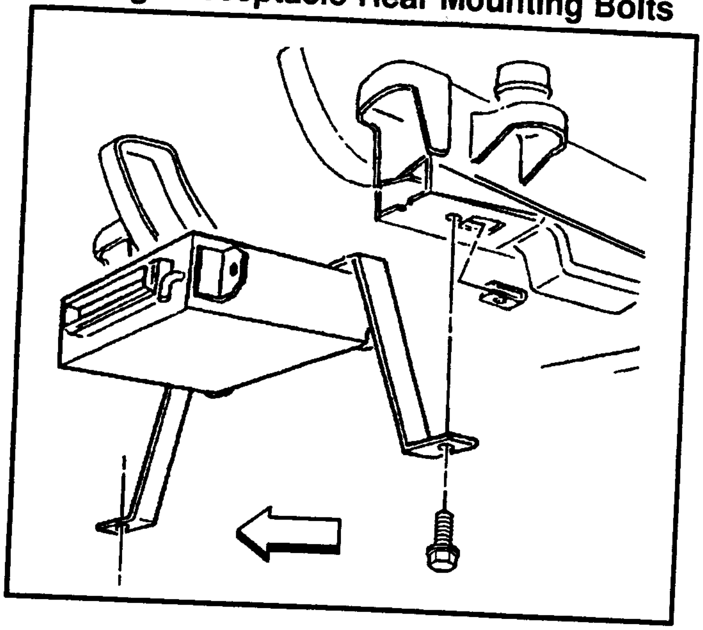


154876

Notice: Do not remove the high voltage charge receptacle cable at the charge receptacle, vehicle damage will occur.

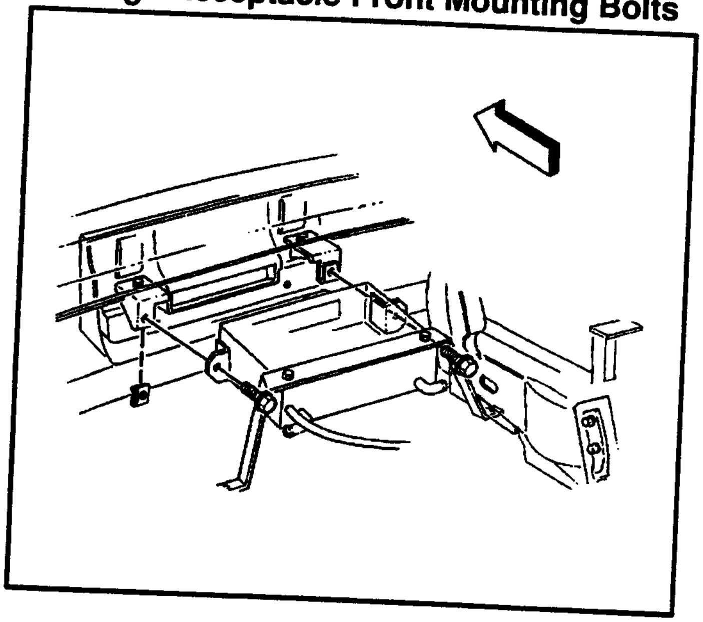
7. Disconnect the charge receptacle high voltage cable at the Power Inverter Module.
8. Feed the charge port high voltage cable down under the vehicle.

Charge Receptacle Rear Mounting Bolts



9. Remove rear charge receptacle mounting bolts.

Charge Receptacle Front Mounting Bolts

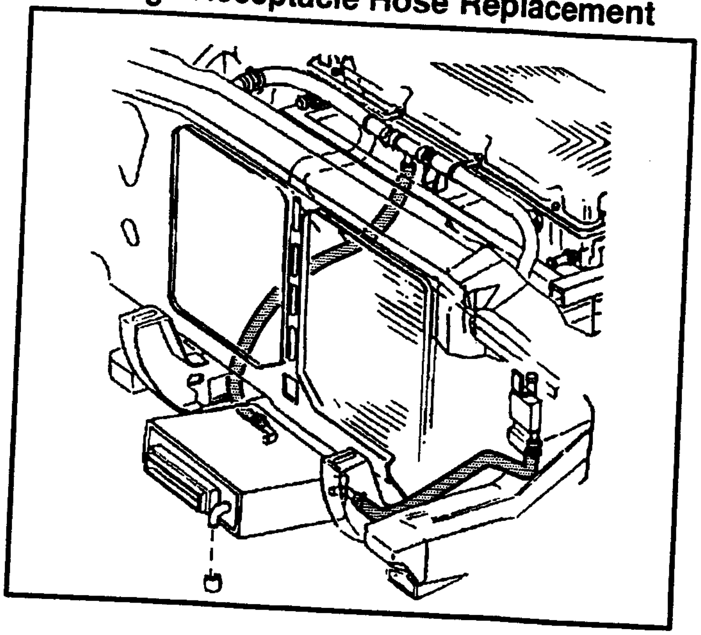


10. Remove front charge receptacle mounting bolts.
11. remove charge receptacle assembly.

Install or connect

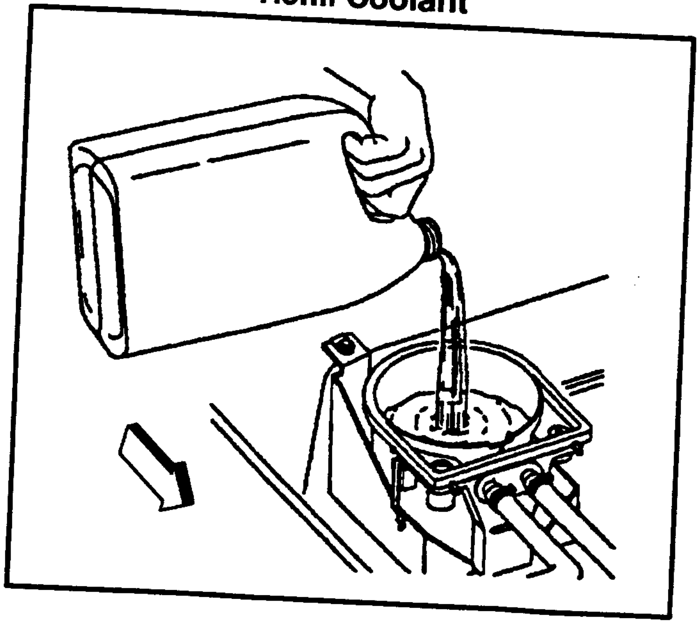
1. Install front charge receptacle mounting bolts. Tighten to 10 N•m (90 lb in).
2. Install rear charge receptacle mounting bolts. Tighten to 10 N•m (90 lb in).
3. Connect the charge receptacle high voltage cable at the drive motor inverter module.
4. Connect the 8 way electrical connector at the charge receptacle.

Charge Receptacle Hose Replacement



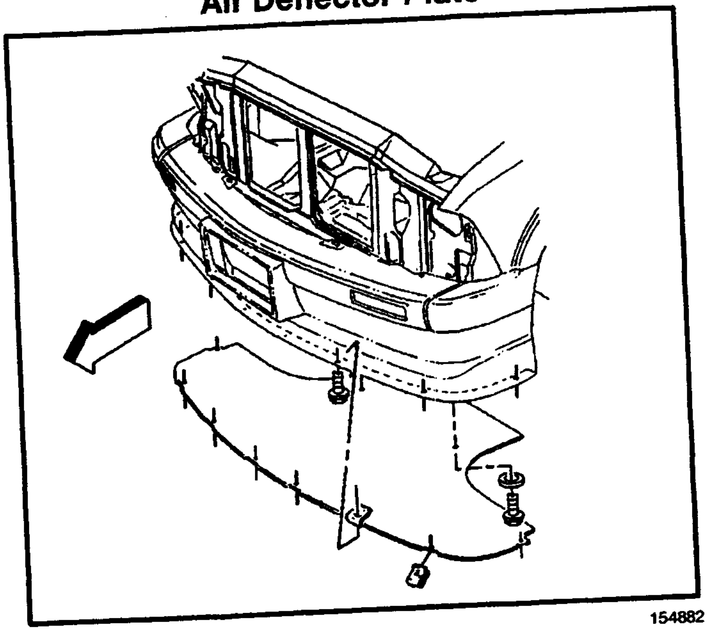
5. Connect the two coolant hoses from the charge receptacle.

Refill Coolant



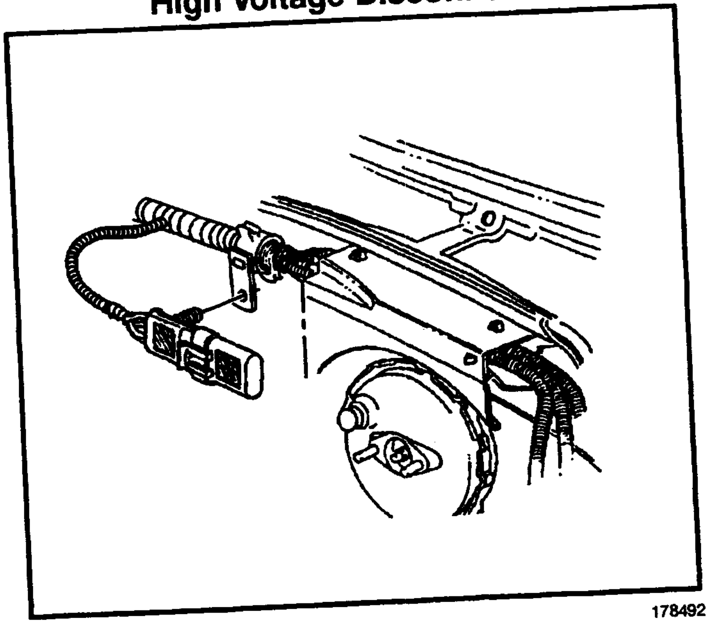
6. Refill the coolant system. Refer to *Coolant Fill Procedure* in *Cooling and Radiator.*

Air Deflector Plate



7. Install the air deflector panel.

High Voltage Disconnect



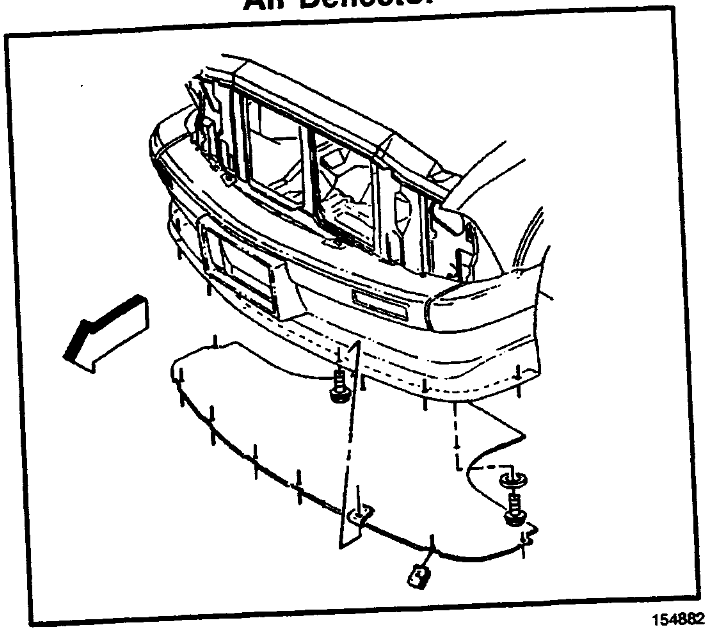
8. Install the Service Disconnect.

Transmission Range Switch

Remove or Disconnect

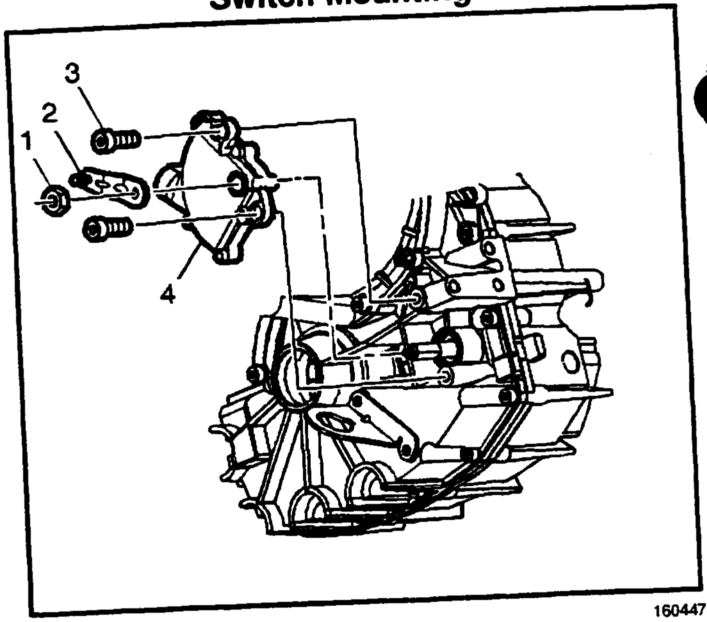
1. Raise vehicle on hoist.
2. Strap vehicle to hoist.

Air Deflector



3. Remove Air Deflector panel.
4. Disconnect the 6-way and 3-way Transmission Range switch connectors.

Transmission Range Indicator Switch Mounting



Legend

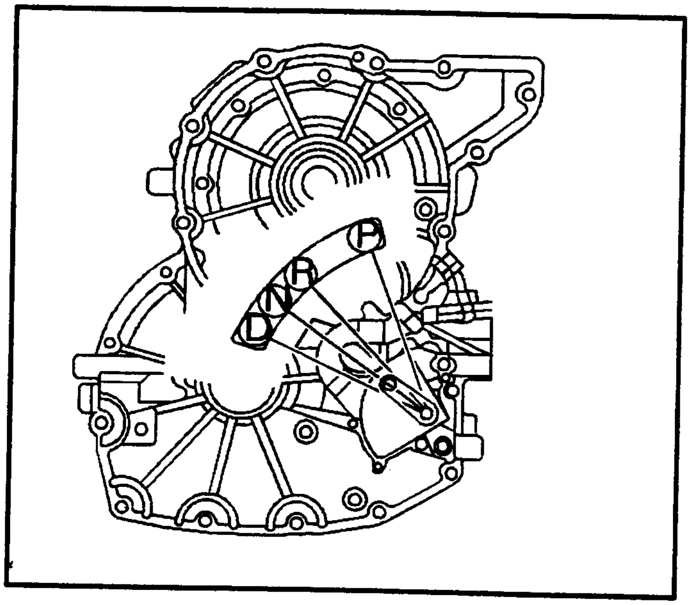
1. Shift Lever Nut.
2. Shift Lever.
3. Mounting Screw.

5. Remove the shift lever nut.
6. Place the shift lever in the NEURAL position by rotating the lever as far counter clockwise as possible and then back clockwise one click.
7. Carefully pry and work lever off shaft.
8. Remove switch mounting screws.
9. Slide the transmission range switch off of the pawl shaft.

Install or Connect

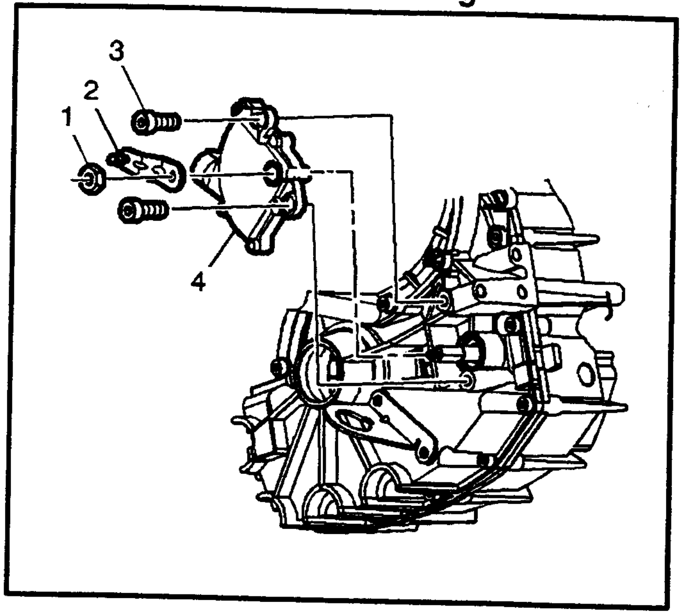
NOTICE: Do not rotate or apply torque to the new switch. The new replacement switch is pinned in the NEUTRAL position for proper installation. Removal of this pin is not necessary, the pin will shear the first time the gear selector is moved.

Transmission Range Indicator Switch Position



1. While holding the transmission range switch with the plastic side toward the bearing housing, align flats in switch insert with flats on pawl shaft. Carefully push switch over the pawl shaft. Fully seat switch against housing.
2. Install mounting screws with conical washers (install with top of cone under screw head) in slots of switch and tighten screws to 23 n•m (17 lb ft).
3. Using a DMM to check continuity, carefully probe the pins in the 6-way connector. With one probe on pin F, zero resistance should be measured between pins F and E, F and D and F and B when the pawl is in the NEUTRAL position and infinite resistance between pins F and C, and pins F and A.

Transmission Range Indicator Switch Mounting

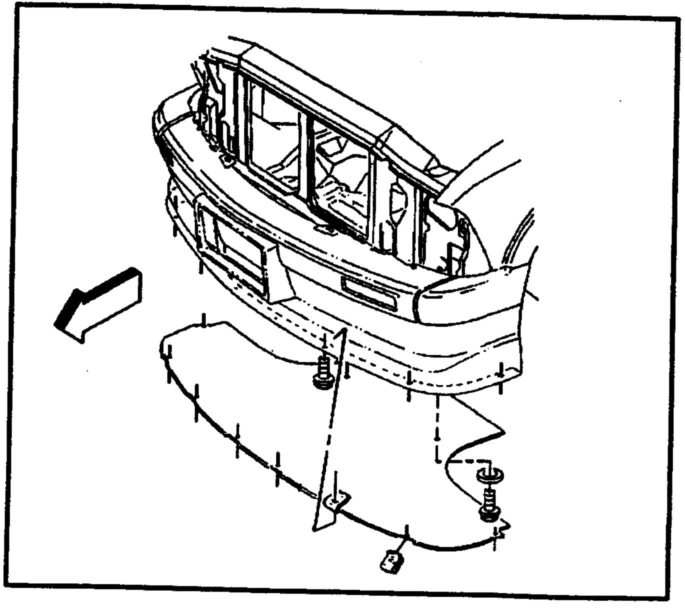


Legend

1. Shift Lever Nut
2. Shift Lever
3. Mounting Screw

4. Install shift lever.
5. Install the new nylon insert and lock nut on pawl shaft and tighten to 23 n•m (17 lb ft).
6. Connect the 6-way and 3-way Transmission Range switch connectors.

Air Deflector



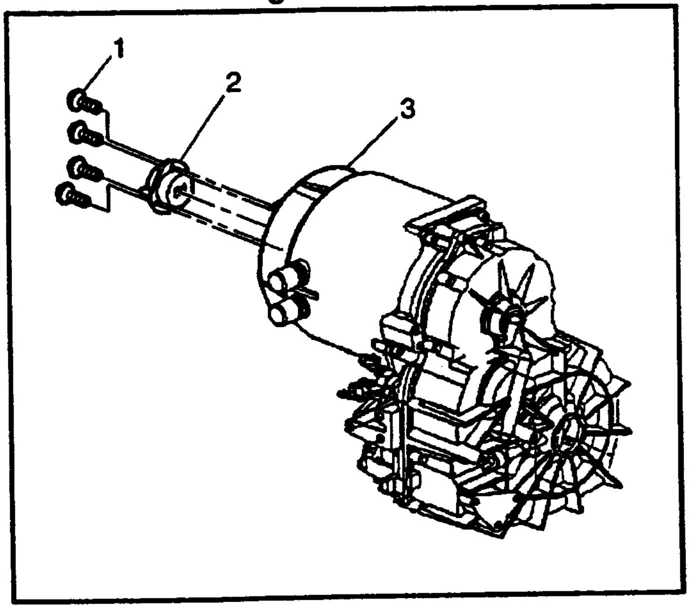
7. Install air Deflector panel.
8. Lower vehicle on hoist.

Drive Motor Speed and Direction Sensor

Remove or Disconnect

1. Remove the Drive Motor assembly. Refer to *Drive Motor Assembly Removal.*
2. Disconnect the speed and direction sensor electrical connector.
3. Shift the Drive Unit to the PARK position.

Mounting Screw Removal



179030

Legend

1. Mounting screws
2. Drive Motor Speed and Direction Sensor
3. Drive motor

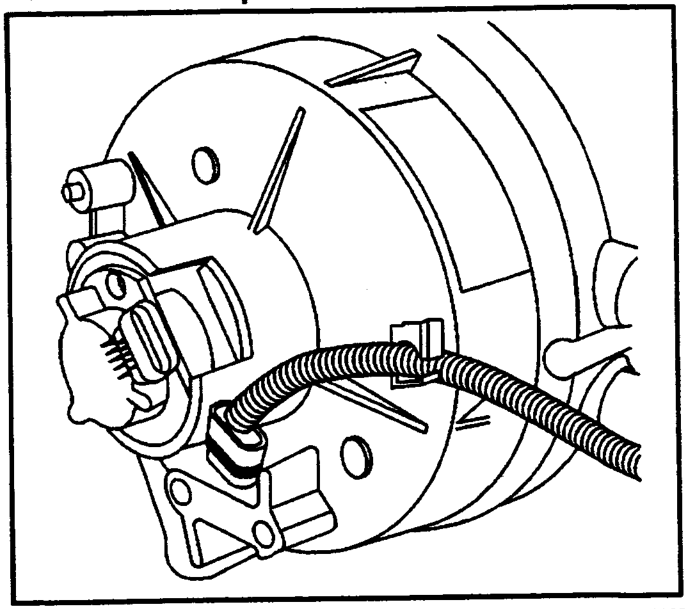
4. Remove the 4 mm hex socket head mounting screws.

Notice: To avoid damage to the speed and direction sensor, the locking pin must be kept in one of the détente positions when the sensor is being removed or installed from the Drive Motor. Allowing the pulse wheel to rattle around inside the housing could cause damage to the speed and direction sensor.

Notice: To avoid damage to the speed and direction sensor, whenever handling the speed and direction sensor body too rotate the sensor to the required position, always grasp the encoder body at the metal flange area. Torque should never be applied to the plastic end cap of the sensor.

5. Grasp the speed and direction sensor at metal flange and carefully pull the sensor barrel out of the drive motor housing bore. Care should be taken not to allow the sensor to free fall once the sensor barrel is clear of the housing bore.
6. Continue to pull the sensor from the housing until firm resistance is felt and sensor can not be further withdrawn. The sensor barrel should not have quite cleared the housing bore at this point, but the sensor connector will be clear of the housing gap to allow rotation of the sensor.

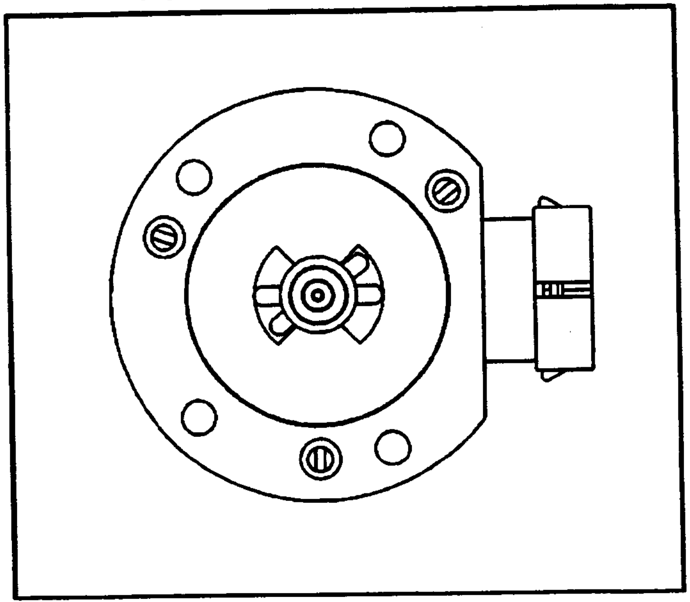
Drive Motor Speed and Direction Sensor



179025

7. While pulling the sensor away from the housing, rotate the speed and direction sensor counter clockwise until the shaft cross pin aligns with the slot in the sensor barrel. the sensor can suddenly be pulled away from the sensor housing approximately another 1/4 inch.

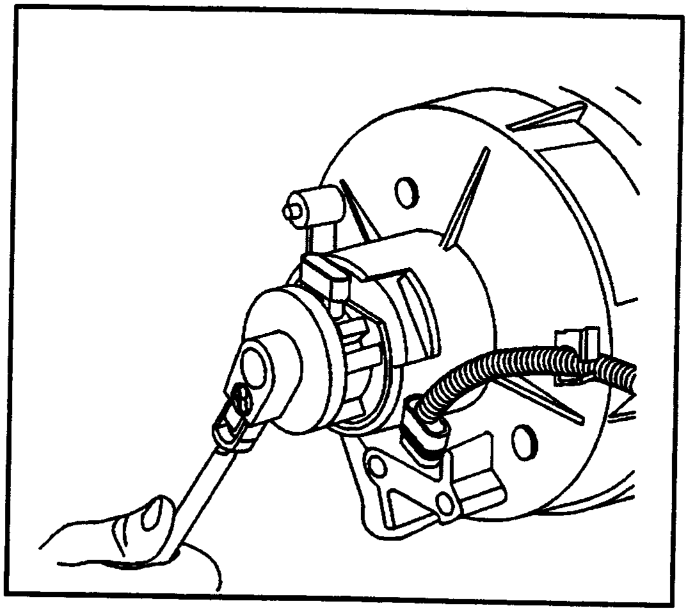
Drive Motor Speed and Direction Sensor Removal Détente Position



174096

8. Continue to hold the speed and direction sensor in line with the slot and rotate the sensor approximately another 30 degrees counter clockwise which will lock the cross pin in the removal détente position. The sensor can be released and will be held in position by the cross pin. The cross pins will not be visible during this step.

Drive Motor Speed and Direction Sensor Removal



179023

9. Using the Drive Motor Speed and Direction Sensor Removal and Installation tool J 42495, rotate the sensor counter clockwise to unscrew the sensor from the drive motor rotor shaft.
10. Remove the sensor and discard the O Ring from the barrel. The O Ring can not be reused.

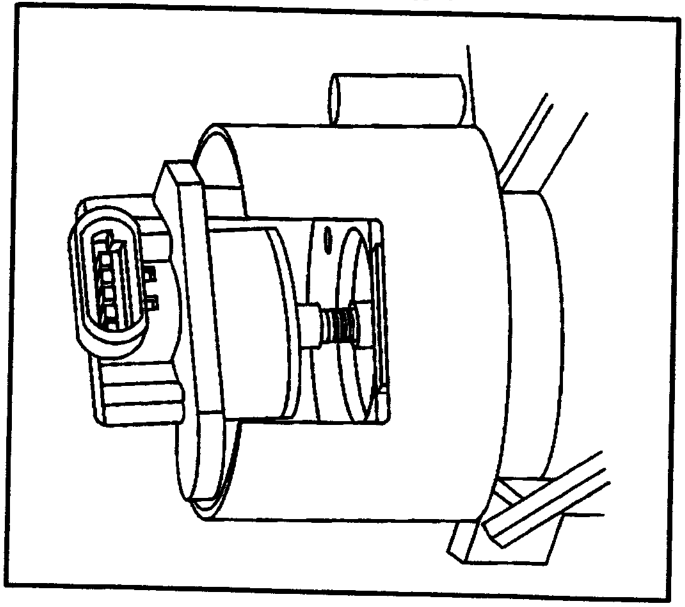
Install or connect

1. Install the new O Ring on the speed and direction sensor.
2. Apply locktite 222 thread locker to the threads on the sensor shaft. Do not use a stronger bonding grade.
3. Note the position of the sensor shaft cross pin. New sensors will come already in the install détente position. If the sensor is in the Install détente position, proceed to step 7. If the sensor is in the removal détente position, proceed to step 4.

Notice: To avoid damage to the speed and direction sensor, the locking pin must be kept in one of the détente positions when the sensor is being removed or installed from the Drive Motor. Allowing the pulse wheel to rattle around inside the housing could cause damage to the speed and direction sensor.

Notice: To avoid damage to the speed and direction sensor, whenever handling the speed and direction sensor body to rotate the sensor to the required position as noted in the following steps, always grasp the Drive Motor Speed and Direction Sensor body at the metal flange area. Torque should never be applied to the plastic end cap of the sensor.

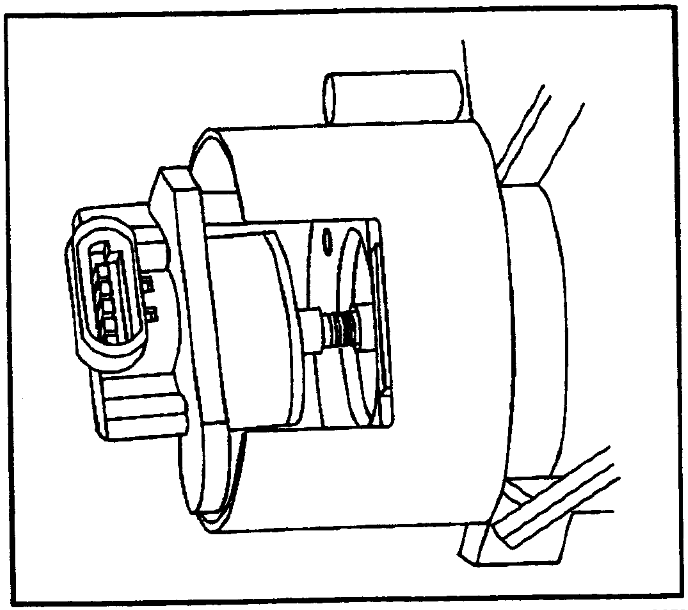
Drive Motor Speed and Direction Sensor Install



179026

4. Install by screwing the sensor into the drive motor rotor shaft by turning clockwise until very lightly seated.
5. Grasp the sensor at the flange and pull away from the motor housing against the détente spring pressure.
6. Rotate the sensor approximately 70 degrees clockwise until you feel the cross pin drop into the install détente position.

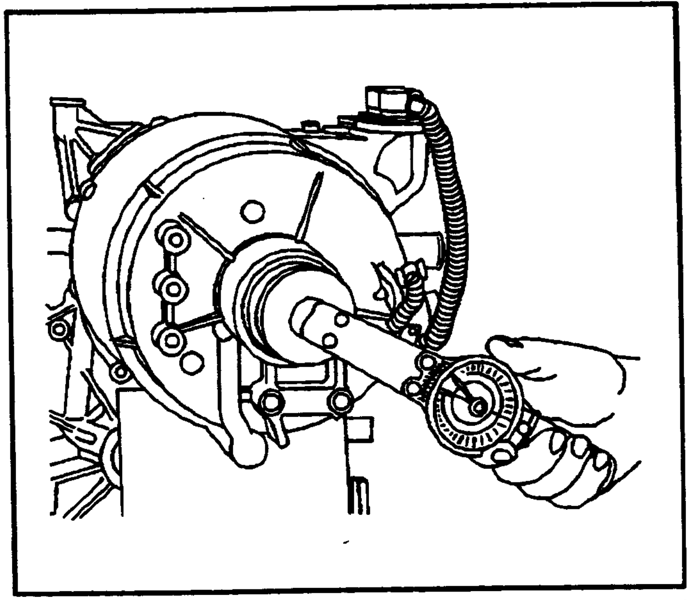
Drive Motor Speed and Direction Sensor Install



179026

7. Install by screwing the sensor into the drive motor rotor shaft by turning clockwise until very lightly seated.

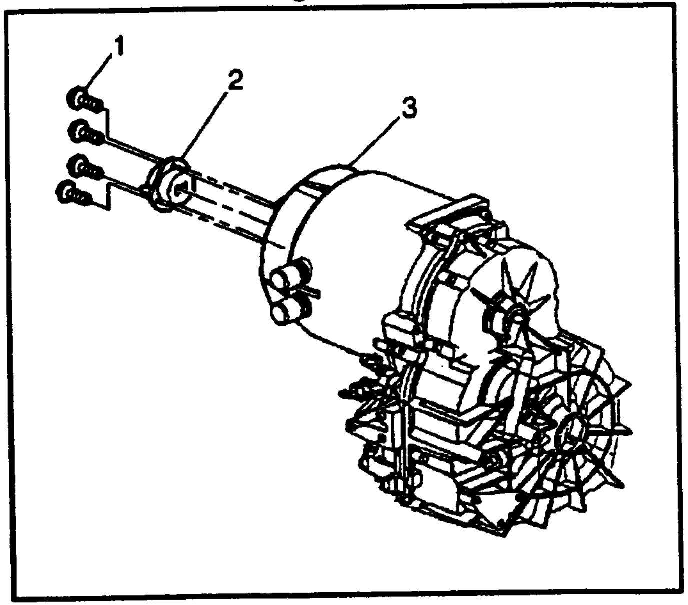
Drive Motor Speed and Direction Sensor Torque



179022

8. Using the Drive Motor Speed and Direction Sensor Removal and Installation tool J 42495, torque sensor to 5.4 nm (48 lb in).
9. Grasp the sensor at the flange and pull away from the motor housing against the détente spring pressure.
10. Rotate the sensor approximately 30 degrees counter clockwise until you feel the cross pin pass through the slot in the sensor housing barrel.
11. Rotate the sensor until the sensor connector aligns with the gap in the motor housing.
12. Press the sensor into the bore of the motor housing.

Mounting Screw Install



179030

Legend
1. Mounting screws.
2. Drive Motor Speed and Direction Sensor.
3. Drive motor.

13. Align the bolt pattern. Install the mounting screws and tighten to 10 nm (90 lb in).

Description and Operation

Drive Motor Control Module

The Drive Motor Control Module and Battery Pack Control Module constantly monitor information from various input sensors and controls the various component systems. Each of these control modules also perform diagnostic tests to ensure that the systems operate correctly and have not degraded to a point where the vehicle may perform incorrectly.

Review the component sections and wiring diagrams to determine which systems are controlled by each specific control module. Each control module monitors numerous vehicle functions and controls the following operations:

Drive Motor Control Module

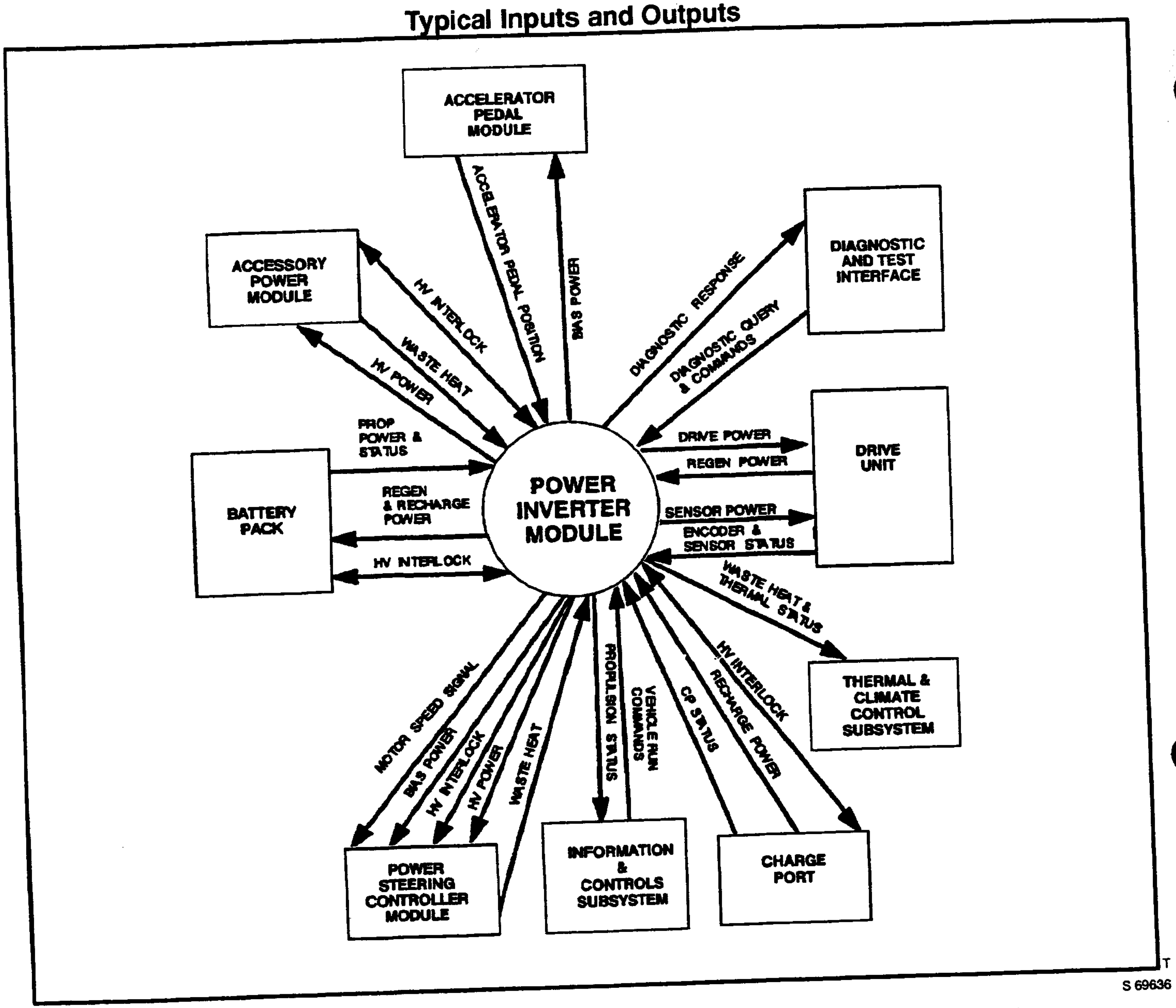
- Drive Motor Shaft Speed and Direction
- Phase Current
- Regeneration
- Drive Motor Temperature

Control Module Function

Each control module supplies a buffered voltage to various sensors and switches. This is accomplished through resistance in the control module which is so high in value that a test light may not illuminate when connected to the circuit. An ordinary shop voltmeter may not give an accurate reading because the voltmeter input impedance is too low. Use a 10 megohm input impedance digital Multimeter (J 39200) to assure accurate voltage readings.

The input/output devices in the control module include analog to digital converters, signal buffers, counters, and special drivers. The Control Module controls most components with electronic switches which complete a ground or voltage output circuit when turned ON. These switches are arranged in groups of 4 and 7, called either a surface mounted Quad Driver Module (QDM), which can independently control up to 4 outputs terminals or Output driver Modules (ODMs) which can independently control up to 7 outputs. Certain outputs may not be used depending on vehicle application.

Typical Inputs and Outputs


ACCELERATOR PEDAL MODULE
ACCELERATOR PEDAL POSITION
BIAS POWER
ACCESSORY POWER MODULE
HV INTERLOCK
WASTE HEAT
HV POWER
DIAGNOSTIC AND TEST INTERFACE
DIAGNOSTIC RESPONSE
DIAGNOSTIC QUERY & COMMANDS
PROP POWER & STATUS
BATTERY PACK
REGEN & RECHARGE POWER
HV INTERLOCK
POWER INVERTER MODULE
DRIVE POWER
REGEN POWER
DRIVE UNIT
SENSOR POWER
ENCODER & SENSOR STATUS
WASTE HEAT & THERMAL STATUS
THERMAL & CLIMATE CONTROL SUBSYSTEM
MOTOR SPEED SIGNAL
BIAS POWER
HV INTERLOCK
HV POWER
WASTE HEAT
PROPULSION STATUS
VEHICLE RUN COMMANDS
CP STATUS
RECHARGE POWER
HV INTERLOCK
POWER STEERING CONTROLLER MODULE
INFORMATION & CONTROLS SUBSYSTEM
CHARGE PORT
T
S 69636

Use Of Circuit Testing Tools

Do not use a test light to diagnose the Powertrain electrical systems unless specifically instructed by diagnostic procedures. Use Connector Test Adapter Kit, J 35616 whenever diagnostic procedures call for probing any connectors.

Control Module Service Precautions

The control module is designed to withstand normal current draws associated with vehicle operations. Avoid overloading any circuit. When testing for opens or shorts, do not ground or apply voltage to any of the control module circuits unless instructed to do so. These circuits should only be tested using digital voltmeter J 39200, while the control module connectors remain connected to the control module or the recommended breakout box

Aftermarket (Add-On) Electrical And Vacuum Equipment

Aftermarket (add-on) Electrical and Vacuum Equipment is defined as any equipment installed on a vehicle after leaving the factory that connects to the vehicles electrical or vacuum systems. No allowances have been made in the vehicle design for this type of equipment.

Notice: No add-on vacuum equipment should be added to this vehicle.

Notice: No add-on electrical equipment should be added to this vehicle.

Add-on electrical equipment, may cause the propulsion control system to malfunction. This may also include equipment not connected to the vehicle electrical system such as portable telephones and radios. Therefore, the first step in diagnosing any Powertrain problem is to eliminate all aftermarket electrical equipment from the vehicle. After this is done, if the problem still exists, it may be diagnosed in the normal manner.

Electrostatic Discharge (ESD) Damage

Electronic components used in the control systems are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. Less than 100 volts of static electricity can cause damage to some electronic components. By comparison, it takes as much as 4,000 volts for a person to even feel the zap of a static discharge.

There are several ways for a person to become static charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a car seat.

Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with the opposite polarity. Static charges can cause damage, therefore, it is important to use care when handling and testing electronic components.

Notice: To prevent possible Electrostatic Discharge damage, follow these guidelines:

- Do not touch the control module connector pins or soldered components on the control module circuit board.
- Do not open the replacement part package until the part is ready to be installed.
- Before removing the part from the package, ground the package to a known good ground on the vehicle.
- If the part has been handled while sliding across the seat, or while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.

Maintenance Schedule

Refer to the *General Motors Maintenance Schedule* for the maintenance that should be performed to retain vehicle performance.

Visual/Physical Underhood Inspection

Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled.

Perform a careful visual and physical underhood inspection when performing any diagnostic procedure or diagnosing the cause of an on-board diagnostic test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection:

- Inspect all wires in the underhood compartment for proper connections, burned or chafed spots, pinched wires, contact with sharp edges.

This visual/physical inspection is very important. It must be done carefully and thoroughly.

Basic Knowledge Of Tools Required

A basic understanding of hand tools is necessary to effectively use this section of the Service Manual.

Notice: Lack of basic knowledge of this Powertrain when performing diagnostic procedures could result in incorrect diagnosis or damage to Powertrain components. Do not attempt to diagnose a Powertrain problem without this basic knowledge.

Wiring Harness Service

The control module harness electrically connects the control module to the various solenoids, switches and sensors in the vehicle engine compartment and passenger compartment.

Replace wire harnesses with the proper part number replacement.

Because of the low amperage and voltage levels utilized in Powertrain control systems, it is essential that all wiring in environmentally exposed areas be repaired with crimp and seal splice sleeves.

The following wire harness repair information is intended as a general guideline only. Refer to Electrical Diagnosis for all wire harness repair procedures.

Connectors And Terminals

Use care when probing a connector and when replacing terminals. It is possible to short between opposite terminals. Damage to components could result. Always use jumper wires between connectors for circuit checking. NEVER probe through Weather-Pack seals. Use tachometer adapter J 35812, or equivalent, which provides a convenient connection to the tachometer lead. The connector test adapter kit J 35616, or equivalent, contains an assortment of flexible connectors used to probe terminals during diagnosis. Fuse remover and test tool BT-8616, or equivalent is used for removing a fuse and to adapt the fuse holder to a meter for diagnosis.

Open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor, or in the wiring harness may temporarily correct the open circuit. Intermittent problems may also be caused by oxidized or loose connections.

Be certain the type of connector/terminal before making any connector or terminal repair. Weather-Pack and Com Pack III terminals look similar, but are serviced differently.

Serial Data Communication

UART Serial Data

Two methods of data transmission are used. One method involves a Universally Asynchronous Receiving/Transmitting (UART) protocol. UART is an interfacing device that allows the on board computer to send and receive serial data. Serial data refers to information which is transferred in a linear fashion - over a single line, one bit at a time. A data bus describes the electronic pathway through which serial data travels. The UART receives data in a serial format, converts the data to parallel format, and places them on the data bus (which is recognizable to the on board computer). The UART also accepts parallel data from the data bus, converts the data to serial format, and transmits them to the Tech 2 or other scan tools. This method has been the common strategy for establishing a communication link between the on board control module and the off board monitor/scanner since 1981.

Class II Serial Data

U.S. Federal regulations require that all automobile manufacturers establish a common communications system. General Motors utilizes the Class II communications system. Each bit of information can have one of two lengths: long or short. This allows vehicle wiring to be reduced by the transmission and reception of multiple signals over a single wire. The messages carried on Class II data streams are also prioritized. In other words, if two messages attempt to establish communications on the data line at the same time, only the message with higher priority will continue. The device with the lower priority message must wait. The most significant result of this regulation is that it provides scan tool manufacturers with the capability of accessing data from any make or model vehicle sold in the United States.

The data displayed on the Tech 2 or other scan tools will appear the same, with some exceptions. Some scan tools will only be able to display certain vehicle parameters as values that are a coded representation of the true or actual value. For more information on this system of coding, refer to section on decimal/binary/hexadecimal conversions. On GM automobiles, the Tech 2 displays the actual values for vehicle parameters. It will not be necessary to perform any conversions from coded values to actual values.

Diagnostic

The word *diagnostic* refers to any on-board test run by the vehicles Diagnostic Management System. A diagnostic is simply a test run on a system or component to determine if the system or component is operating according to specification.

Enable Criteria

The term enable criteria is engineering language for the conditions necessary for a given diagnostic test to run. Each diagnostic has a specific list of conditions which must be met before the diagnostic will run. Enable criteria is another way of saying conditions required.

The enable criteria for each diagnostic is listed on the first page of the DTC description under the heading Conditions for Setting the DTC. Enable criteria varies with each diagnostic.

Freeze Frame

Freeze Frame is an element of the Diagnostic Management System which stores various vehicle information at the moment an emissions-related fault is stored in memory and when a MIL is commanded on. This data can help to identify the cause of a fault. Refer to *Storing And Erasing Freeze Frame Data* for more detailed information.

Failure Records

Failure Records data is a GM enhancement of the OBD II Freeze Frame feature. Failure Records store the same vehicle information as does Freeze Frame, but it will store that information for any fault which is stored in on-board memory, while Freeze Frame stores information only when the MIL is commanded on.

Diagnostic Information

The diagnostic charts and functional checks are designed to locate a faulty circuit or component through a process of logical decisions. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are not multiple faults present.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complimented by the diagnostic procedures contained in this manual. The language of communicating the source of the malfunction is a system of diagnostic trouble codes. When a malfunction is detected by a control module, a diagnostic trouble code is set and a Malfunction Indicator Lamp (MIL) SERVICE SOON, SERVICE NOW or Batt Life may be illuminated.

Malfunction Indicator Lamps (MILs)

The Malfunction Indicator Lamps (MILs) may be turned on when one or more control modules detect a fault that requires a DTC to be set.

Each MIL is under the control of a specific control module. Any control module can send a MIL illumination request to another control module through the serial data line. Direct MIL illumination responsibilities are as follows:

Drive Motor Control Module

- TEMP
- SERVICE SOON

Battery Pack Control Module

- SERVICE NOW
- BATT LIFE
- WAIT

Extinguishing the MIL

When the MIL is on, the control module may turn off the MIL as soon as a test passed has been reported for the diagnostic test that originally caused the MIL to illuminate.

Although the MIL has been turned off, the DTC will remain in the memory (both Freeze Frame and Failure Records).

When the MIL remains ON or when a malfunction is suspected due to a driveability problem, a *On-Board Diagnostic (OBD) System Check must be performed.* The procedures for these checks are given in Propulsion Control Systems. These checks will expose faults which may not be detected if other diagnostics are performed first.

Storing And Erasing Freeze Frame Data and Failure Records

Government regulations require that engine operating conditions be captured whenever the MIL is illuminated. The data captured is called *Freeze Frame* data. The freeze frame data is very similar to a single record of operating conditions. Whenever the MIL is illuminated, the corresponding record of operating conditions is recorded to the freeze frame buffer.

Freeze frame data can only be overwritten with data associated with a misfire or fuel trim malfunction. Data from these faults take precedence over data associated with any other fault. The freeze frame data will not be erased unless the associated history DTC is cleared.

Each time a diagnostic test reports a failure, the current operating conditions are recorded in the *Failure Records* buffer. A subsequent failure will update the recorded operating conditions. The following operating conditions for the diagnostic test which failed *typically* include the following parameters:

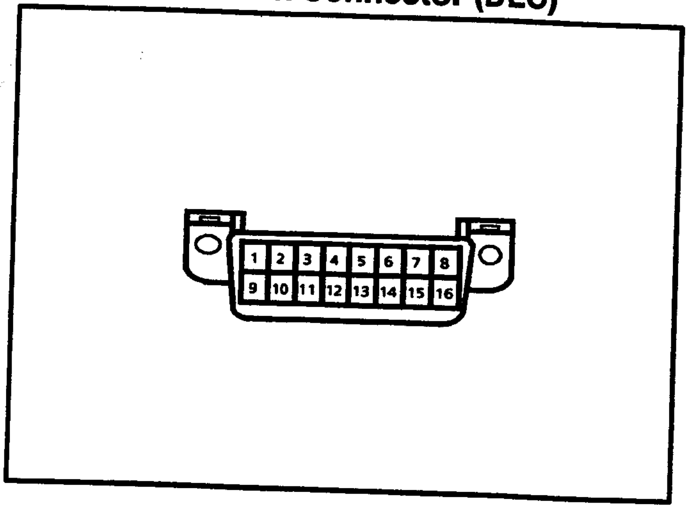
- Battery State of Charge
- Battery assembly Temperature
- Drive Motor Temperature
- Inverter Module Temperature
- Drive Motor Shaft Speed
- Drive Motor Shaft Direction
- System High Voltage State

Intermittent Malfunction Indicator Lamp

In the case of an intermittent fault, the MILs (SERVICE SOON, SERVICE NOW or Batt Life) may illuminate and then (after a diagnostic pass) go OFF. However, the corresponding diagnostic trouble code will be stored in the memory. When unexpected diagnostic trouble codes appear, check for an intermittent malfunction.

A diagnostic trouble code may reset. Consult the Diagnostic Aids associated with the diagnostic trouble code. A physical inspection of the applicable sub-system most often will resolve the problem.

Data Link Connector (DLC)



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Data Link Connector (DLC)

The provision for communicating with the control module is the Data Link Connector (DLC). It is usually located under the instrument panel. The DLC is used to connect to a scan tool. Some common uses of the scan tool are listed below:

- Identifying stored Diagnostic Trouble Codes (DTCs).
- Clearing DTCs
- Performing output control tests.
- Reading serial data.

Decimal/Binary/Hexadecimal Conversions

Beginning in 1996, Federal Regulations require that all auto manufacturer selling vehicles in the United States provide scan tool manufacturers with software information to display vehicle operating parameters. All scan tool manufacturer will display a variety of vehicle information which will aid in repairing the vehicle. Some scan tools will display encoded messages which will aid in determining the nature of the concern. This method of encoding involves the use of a two additional numbering systems: Binary and Hexadecimal.

The binary number system has a base of two numbers. Each digit is either a 0 or a 1. A binary number is an eight digit number and is read from right to left. Each digit has a position number with the farthest right being the 0 position and the farthest left being the 7 position. The 0 position, when displayed by a 1, indicates 1 in decimal. Each position to the left is double the previous position and added to any other position values marked as a 1.

The hexadecimal system is composed of 16 different alpha numeric characters. The alpha numeric characters used are numbers 0 through 9 and letters A through F. The hexadecimal system is the most natural and common approach for scan tool manufacturers to display data represented by binary numbers and digital code.

Reprogramming (Flashing) The Control Modules

Some vehicles allow reprogramming of the control module without removal from the vehicle. This provides a flexible and a cost-effective method of making changes in software and calibrations.

Reprogramming the Battery Pack Control Module will effect the learned state of charge value that is shared with the Drive Motor Control Module and the state of charge gauge on the dash. In order for the Battery Pack Control Module to relearn the SOC the key should be cycled twice immediately after reflashing then the battery pack must be charged to completion.

Verifying Vehicle Repair

Following a repair, the technician should perform the following steps:

1. Review and record the fail records and/or freeze frame data for the DTC which has been diagnosed.
2. Clear DTC(s).
3. Operate the vehicle within conditions noted in the fail records and/or freeze frame data.
4. Monitor the DTC status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

Following these steps are very important in verifying system repairs. Failure to follow these steps could result in unnecessary repairs.

Reading Diagnostic Trouble Codes Using a Tech 2 or Other Scan Tool

The procedure for reading diagnostic trouble code(s) is to use a diagnostic scan tool. When reading DTC(s), follow instructions supplied by tool manufacturer.

Clearing Diagnostic Trouble Codes

Important: Do not clear DTCs unless directed to do so by the service information provided for each diagnostic procedure. When DTCs are cleared, the Freeze Frame and Failure Record data which may help diagnose an intermittent fault will also be erased from memory.

If the fault that caused the DTC to be stored into memory has been corrected, the Battery Pack Control Module will begin to count the Power Transfer Cycles. When it has counted 100 consecutive cycles with no further faults detected, the DTC will automatically be cleared from memory. The Drive Motor Control Module will store history DTCs until manually removed.

To clear Diagnostic Trouble Codes (DTCs), use the diagnostic scan tool clear DTCs or clear information function. When clearing DTCs follow instructions supplied by the tool manufacturer. In some cases it may be necessary to cycle the key after the fault is no longer present in order to clear DTCs with the scan tool.

DTC Modes

Use the DTC Info mode to search for a specific type of stored DTC information. There are several choices. The service manual may instruct the technician to test for DTCs in a certain manner. Always follow published service procedures.

To get a complete description of any status, press the Enter key before pressing the desired F-key. For example, pressing enter, then a F key will display a definition of the abbreviated scan tool status.

Current DTC

This message displayed indicates that the diagnostic test has failed at least once during the current ignition cycle. This message will clear when DTCs are cleared or the ignition is cycled.

History DTC

This message displayed indicates that the DTC has been stored to memory as a valid fault. A DTC displayed as a History fault does not necessarily mean that the fault is no longer present. The history description means that all the conditions necessary for reporting a fault have been met (maybe even currently) and the information was stored to the control module memory.

MIL Requested

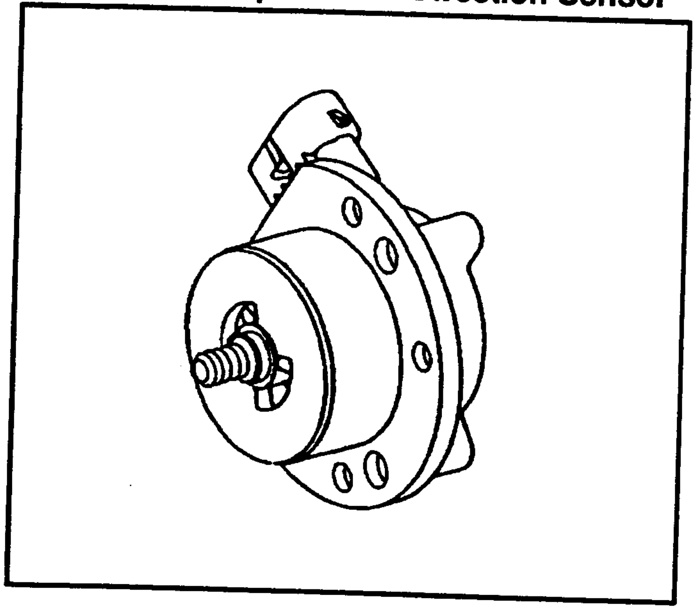
This message displayed indicates that the DTC is currently causing the MIL to be turned ON. The MIL request cannot be used to determine if the DTC fault conditions are currently being experienced.

Failure Records

Failure records are stored in system memory for some diagnostic trouble codes. Failure records show the conditions the vehicle was in at the time the DTC set. This information may be useful when trying to duplicate conditions for intermittent problems. In the case of the S-10 electric this information is also useful in determining the battery pack state of charge at the time a battery module DTC sets.

Information Sensors

Drive Motor Speed and Direction Sensor



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Drive Motor Speed and Direction Sensor

The Drive Motor Control Module uses and monitors the shaft speed signal for several different functions including vehicle speed, torque control, and cruise control. The Bias Control Assembly generates the Drive Motor Speed and Direction signal which has 1 pulse for every 1 pulses of the shaft Drive Motor Speed and Direction Sensor signal. The Drive Motor Speed and Direction Sensor is located in the left hand side of the Drive Motor.

Bias Control Assembly (BCA)

The BCA is like another Drive Motor Control Module except controlling different functions. The BCA provides 12 volt power and ground for the drive motor speed sensor which it receives and process a signal to provide speed and direction input to the Drive Motor Control Module.

The BCA also monitors and controls the high voltage within the Power Inverter Module based on commands from the Drive Motor Control Module (current and slip command). If the BCA detects a fault in its system it will send a message to the Drive Motor Control Module to set a DTC and store data.

IGBT

The IGBTs are high power transistors used to rectify the DC voltage to AC and provide current to the three phase drive motor. They also provide the AC to DC conversion during regeneration to recharge the batteries.

Power Steering Control Module

The Power Inverter Module provides filtered high voltage DC power to the PSCM with an associated high voltage interlock. The maximum amps supplied to the PSCM is five amps. The Power Inverter Module also provides a chassis ground and conducts thermal energy from the PSCM.

Accelerator Pedal Position Sensor

The PIM provides variable output drive motor torque current based on the accelerator pedal position sensor. The resulting position will be converted to a current request based on vehicle speed and high voltage bus voltage. The PIM provides sensor power on three independent lines, each running a separate potentiometer within the APP.

Critical Fault

A critical fault is any BCA reported fault with the exception of DMCM DTC 043.

Non-critical Fault

A non-critical fault is a BCA reported fault that related to the drive motor speed and direction sensor DTC 043.

Discrete Input

A discrete input describes a method of transmitting information from a control module or component to another control module without the use of serial communications. This is normally done by using a signal wire that changes electrical state to indicate the presence or absence of a monitored condition. Due to the nature of discrete inputs 1 bit of data is exchanged between components, the line is simply ON or OFF.

Battery Pack Power

Drive motor battery pack power describes nominal 320 volt supply from 26 separate battery modules connected in series. The battery assembly is the fundamental vehicle power source the runs the drive motor and charges the 12 volt auxiliary battery through the Accessory Power Module. The Battery Pack is charged through the vehicle charge port.

Auxiliary Battery Power

The auxiliary power on the electric S-10 represents the vehicles normal 12 volt accessory operating system. The storage device for this 12 volt supply is a typical automotive lead acid battery which is located in the engine compartment. Charging voltage is supplied to the auxiliary battery through the Accessory Power Module at a nominal 14 volts. The voltage supplied by the auxiliary battery is used for initial system power-up as well as the operation of all components with the exception of: Drive Motor, Heat Pump Compressor, Power Steering.

Phase Current

Phase current is a term used to describe the power used to turn the drive motor. Each of the three phases in the drive motor require sequential current in order to turn the drive motor shaft. The level of phase current supplied to the drive motor is determined by the Drive Motor Control Module and is dictated by inputs such as load and throttle request.

Regeneration

The PIM provides a regeneration function which allows the drive unit to supply negative shaft torque. In this mode the drive unit and the PIM act as a generator providing current to the battery assembly for storage. two different levels of regeneration are possible. During normal vehicle deceleration a maximum of 15% regeneration is allowed. During braking however, a maximum of 25% regeneration can be produced.

Vehicle Speed Limiting

The Power Inverter Module will limit vehicle speed in the forward direction to 70 mph and in reverse direction to 30 mph.

True State Of Charge (TSOC)

State of charge is a value determined by the Battery Pack Control Module. The Battery Pack Control Module constantly monitors battery assembly voltage and through numerous calculations determines a state of charge value. This value is used to calculate the approximate range and power level of the battery pack. SOC is constantly changing based on inputs to the BPCM. The factors that effect SOC are:

- Average battery pack temperature
- Lowest battery module voltage and current
- Pack voltage
- Amp-hours lost due to parasitic discharge
- Amp-hours lost due to battery pack self discharge
- Age of the batteries
- Amp-hours used
- Average current usage
- Battery pack capacity
- Battery pack capability

The Battery Pack Control Module stores the last rated, usable energy that a pack has whenever the charging complete criteria is met. From this point the Battery Pack Control Module is continually summing up how many amp-hours are flowing into and out of the battery pack.

The summing of discharging amp-hours is corrected for the temperature of the pack, the lowest battery module voltage and the rate (amps) at which current is flowing out of the batteries. The higher the temperature , the less each amp-hour counts, warm batteries react easier and are more efficient. The greater the rate (the more accelerator input), the more each amp hour count. With batteries being in a series string, the weak link controls the energy of the entire battery pack. If one module is at 35 amp-hours and the rest of the modules are at 48 amp-hours, the usable energy from the pack is only 35 amp-hours.

During charging the amp-hours going into the pack are summed up until the completion criteria is met.

Because the battery is a chemical reaction, as with all chemical reactions, temperature of the pack has an absolute affect on SOC. Therefore, the SOC will be compensated to a proportionally lower value for low pack temperatures.

User State Of Charge (USOC)

The Battery Pack Control Module then sends the calculated SOC value reduced by 15% to the Drive Motor Control Module through serial data. This 15% reduction from true SOC is intended to prevent the driver from running the Drive motor batteries down to a very low state of charge. The Drive Motor Control Module sends a PWM signal to the Vehicle Interface Module which converts the digital PWM signal to analog for the dash gauge. The Body Control Interface Module PWM conversion is performed based on 0% PWM = 100% SOC, and 100% PWM = 0% SOC.

Drive Motor Slip

Voltage will be induced in the rotor, provided that the rotors conductors continue to cut across the magnetic flux lines of the stator field. To make sure this happens it is necessary for the rotor to travel at a speed somewhat less than the synchronous speed of the stators rotating field. The difference between the synchronous speed and the actual rotor or motor speed is referred to as slip and is usually expressed as a percentage of synchronous speed. For any induction motor to produce torque they must have slip.

Accessory Power Control Module

The Accessory Power Module has three major functions; provide 14.5 volts DC for the Auxiliary battery and 12 volt system, 3-phase AC voltage for the heat pump, and feedback to the HTCM about system operation to help diagnosis problems.

While the Accessory Power Module receives DC voltage that may vary from 225 to 430 volts, it must hold its output DC voltage steady for the Auxiliary battery. Additionally, the Accessory Power Module converts DC voltage to AC voltage to operate the heat pump compressor motor.

The Accessory Power Module will operate on drive motor battery voltage between 225-430 volts. The Accessory Power Module will shut itself down if the voltage drops below 215 volts ± 10 volts. The Accessory Power Module will turn on when the vehicle run commend or vehicle wake-up command inputs are active.

The Power Inverter Module provides filtered high voltage DC power to the Accessory Power Module for distribution with an associated high voltage interlock. The maximum amps supplied to the APM is 22 amps. The Power Inverter Module receives vehicle accessory power and conducts thermal energy from the Accessory Power Module . The Power Inverter Module also supplies a ground path for the Accessory Power Module.

High Voltage Interlock Loop

The High Voltage Interlock Loop is a separate low voltage series circuit that runs along with all of the high voltage circuits. All of the high voltage DC connectors and cover switches are tied together in an isolated series single wire interlock loop allowing the auto disconnect to detect a disconnect of a high voltage component. The auto disconnect accomplishes this by applying 7.9 - 10.6 volts to the interlock loop circuit to check for a continuous loop. If a continuous loop is present the auto disconnect will monitor this voltage for a voltage drop. If a voltage between 0 -2.0 volts is detected the auto disconnect will open the relays and report this information to the BPCM. At this time the Power Inverter Module will discharge the bus capacitors so that the bus voltage is less than 42.4 volts within 250 milliseconds. The normal interlock loop voltage is 3.2 to 7.3 volts.

Run 1 Power

Run 1 power is the 12 volt aux. battery supplied voltage used to initiate vehicle operation through the ignition switch. When the key is turned forward the run 1 circuit is energized and base power is supplied to the primary control modules.

Run 2 Power

Run 2 power is the 12 volt supply that is needed to initiate propulsion. Run 2 power is controlled through the HTCM and supplied by the run 2 relay located behind the glove box.

Charge Receptacle

The PIM receives power from the charge receptacle which is then filtered and high voltage DC is distributed to the batteries and operating accessories at the time of charging. The PIM and charge receptacle are also interfaced with a high voltage interlock. The PIM monitors the charge receptacle for a connection present signal (charge coupler installed in charge receptacle). The PIM also provides a ground path for the charge receptacle.

Charger Communications

The charger communicates with the Battery Pack Control Module on the class II data bus. Radio transmitter/Receivers located in the charger and charge port exchange information while the charge paddle in inserted into the vehicle. Information is passed relating to charger faults, state of charge, current request, charge time, ect.

Vehicle Wake-up

The vehicle wake-up circuit is used to activate only the systems needed to charge the Battery Pack Assembly with the ignition switch off. At the time the charge paddle is inserted into the charge port a 12 volt supply is sent to the Battery Pack Control Module and the HTCM. At the same time the charger begins sending class II messages on the bus informing the Battery Pack Control Module that vehicle charging is ready to take place. Once the charge paddle is removed from the vehicle the 12 volt wake-up power is removed

Automatic High Voltage Disconnect

The automatic disconnect is located inside and receives power from the Battery Pack Assembly. If the auto disconnect detects or receives information from another control module that there is a problem with the high voltage system it will open the high voltage relays. Problems with the high voltage range from interlock loop faults to loss of ground in a high voltage component.

Special Tools and Equipment

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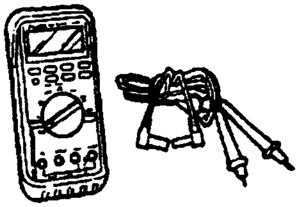
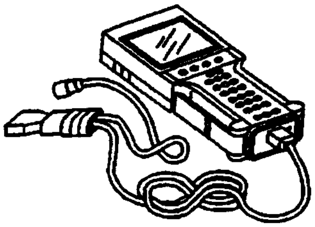
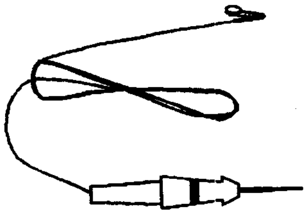
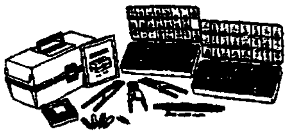
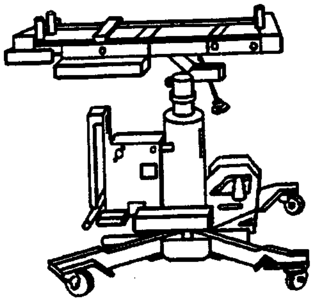
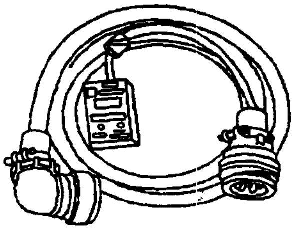
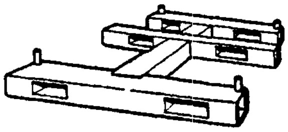
	J 39200 Digital Multimeter
	Tech 2 Scan Tool
	J 34142-B 12 Volt Test Light
	J 38125-A Packard Terminal Repair Kit
	J 42187 Battery Pack Lift Table
	J 42493 Battery Pack to Power Inverter Module Extension
	J 42500 Battery Pack Support Tray

Special Tools and Equipment

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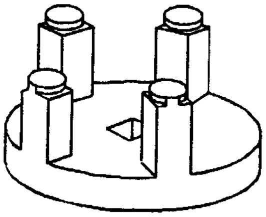
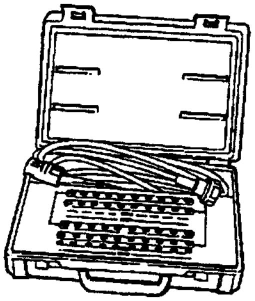
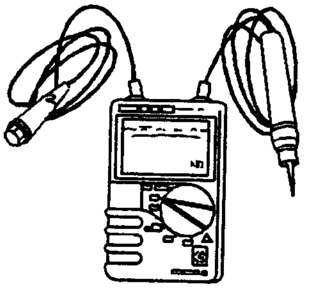
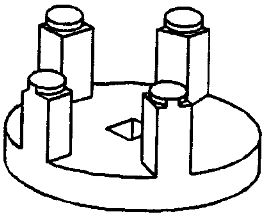
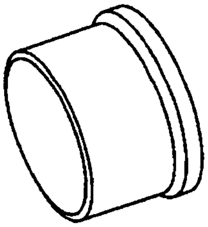
 174065	J 42241 Forward/Reverse Signal Generator
 182422	J 42494 Battery Pack Breakout Box
 160332	J 42502 Digital Insulation Tester
 174065	J 42495 Drive Motor Speed and Direction Sensor Removal Tool
 182400	J 42503 Cannon Connector Cover

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General Description

Before using this section of the manual, you should be familiar with the information and proper diagnosing procedures as described latter in the section. This section contains an On-Board Diagnostic (OBD) System Check. The on-board diagnostic system check is an organized approach in order to identify a problem created by a control module system malfunction. The on-board diagnostic system check must be the starting point for any driveability complaint diagnosis. The on-board diagnostic system check will direct you to the next logical step in diagnosing the complaint. Understanding the chart and using it correctly will reduce diagnostic time and prevent unnecessary replacement of good parts.

This section applies to the Electric "S" Truck Battery Pack Diagnosis and repair.

Battery Pack Control Module

The Battery Pack Control Module is designed to process various input information and send the necessary electrical responses to the other control modules. The input information has an interrelation to more than one output, therefore, if one input fails it can affect more than one systems operation.

Fastener Tightening Specifications

Application	Nm	Lb Ft	Lb In
Drive Motor Speed and Direction Sensor Mounting Bolts	10	7	90
Transmission Range Switch Mounting Screws	23	17	204
Transmission Pawl Shaft Lock Nut	23	17	204
Battery Charge Receptacle Mounting Front Mounting Bolts	10	7	90
Battery Charge Receptacle Mounting Rear Mounting Bolts	10	7	90
Upper Power Inverter Module to subframe Mounting Bolts	65	48	—
Lower Power Inverter Module to subframe Mounting nut.	32	24	283
Power Steering Control Module Mounting Screws	5.6	4	50
Accessory Power Control Module Mounting Screws	5.6	4	50
Accelerator Pedal Mounting Nuts	10	7	90
APM Positive and Negative Cable Retaining Nuts	18	13	159

Service Parts Group Numbers

Application	GM SPO Group Number
Drive Motor assembly	0.000
Drive Motor Speed and Direction Sensor	3.682
Transmission Range Switch	4.054
Battery Charge Receptacle	2.215
Power Inverter Module	2.200
Power Steering Control Module	6.605
Accessory Power Control Module	2.200
Accelerator Pedal	3.451
Body Control Interface Module	2.560
Power Inverter Module Relay (Run 2)	2.200
Battery Pack Blower Air Flow Sensor	2.212
Battery Pack Air Inlet temperature sensor	2.212

Typical Scan Tool Data Values

Scan Tool Data - Battery Pack Control Module

Vehicle powered up/Closed Throttle/Park or Neutral/Acc. "OFF"

Scan Tool Parameter	Units Displayed	Typical Data Value
Battery 1-26	Volts	12.90
Battery Temp Sensor 1-6	°C (°F)	~
Battery Pack Airflow Sensor	%	~
Battery Pack Air Inlet Temp Sensor	°C (°F)	~
Battery Pack	Volts	330.0
Battery Pack	Amps	-1.3
Accessory Power	Volts	14.0
Run 1	On / Off	On
Vehicle Wake-up	Yes / No	Yes
Commanded Vehicle Wake-up	Yes / No	Yes
Battery Pack Control Module Power Down	Yes / No	No
Park Selected	Yes / No	Yes
No Coolant Present	True / False	False
HTCM Regen Charge Disabled	Yes / No	No
Battery Pack Current	Fault / No Fault	No Fault
Battery Pack Temp	Fault / No Fault	No Fault
Battery Pack Voltage	Fault / No Fault	No Fault
Charge Receptacle Over Temp	Fault / No Fault	No Fault
Charge Receptacle Temp Circuit	Open / Closed	Open
Charger Transfer Mode	Standby, Ready, Transfer, Fault	Standby
Vehicle Ready	Yes / No	No
Vehicle Run	Yes / No	Yes
Vehicle Wake-up	Yes / No	Yes
Charger Communication	Yes / No	No
Park Selected	Yes / No	Yes
Charge Receptacle Temperature	°C (°F)	~
Charge Receptacle CKT.	Open / Closed	Open
Commanded Auto Disconnect	Normal, Inhibit, Disconnect	Normal
Auto Disconnect State	Normal, Fail, Commanded, Loop, Precharge, Low_V, Ground, Isolation, Ps_Fail, Invalid	Normal
Battery Pack Control Module Periodic Wake-up	On / Off	On
Propulsion System Status	Standby, Propel, Charge, Terminate_Charger, Precondition, Shutdown	Propel
Charge Status	Charging, Updating, Equalizing, Floating, Fault, Reset	Reset
True SOC	%	100
Battery Pack Air Inlet Temp Sensor	°C (°F)	~

Typical Scan Tool Data Definitions

The following information will assist in diagnosing symptom or derivability problems. The displays can be viewed while the vehicle is being driven. Refer to *On Board Diagnostic (OBD) System Check* for additional information.

Scan Tool Display

Battery 1-26:

Displays the voltage of each battery module.

Battery Temp Sensor 1-6:

Displays the temperature at six locations within the battery pack. Temperature sensors are located on negative end of battery modules #8, 13, 18, 24, 25, and 26.

Battery Pack Airflow Sensor:

Displays the amount of airflow going into the battery pack as seen by the airflow sensor.

Battery Pack Air Inlet Temp Sensor:

Displays the temperature of the air entering the battery pack via the fan and thermal system.

Battery Pack:

Displays the voltage of the battery pack. The voltage is the result of the sum of all 26 modules.

Battery Pack:

Displays the current flowing in the battery pack that is used for control purposes. The current is measured at the shunt in the battery pack (Positive current equals charging).

Accessory Power:

Displays the value of aux. battery voltage that the Battery Pack Control Module is receiving.

Run 1:

Displays ON when the Battery Pack Control Module receives Run 1. Run 1 is not active during charging.

Vehicle Wake-up:

Displays YES when the HTCM or the charge receptacle command the wake-up line. The HTCM commands the wake-up line for aux. battery charging and thermal system operation.

Commanded Vehicle Wake-up:

Displays YES when the Battery Pack Control Module asserts the wake-up line to the HTCM and Accessory Power Control Module for Aux battery charging and pack heating or cooling.

Battery Pack Control Module Power Down:

Displays YES when the Battery Pack Control Module commands the hardware to power down. This takes place as soon as all external hardware inputs permit.

Park Selected:

Displays YES when the Transmission Range Switch is in Park. This is read by a discrete line to the Battery Pack Control Module from the Transmission Range Switch.

Commanded Accessory, Power:

Displays Yes when the Battery Pack Control Module requests for the Accessory Power Control Module Power.

Comm. Battery Pack Fan:

Displays YES when the battery pack fan is commanded ON by the Battery Pack Control Module.

No Coolant Present:

Displays TRUE when the HTCM reports that the coolant level is too low to cool the charge receptacle.

HTCM Regen Charge Disabled:

Displays DISABLE when the HTCM detects an over-temperature failure.

Battery Pack Current:

Displays FAULT when the Battery Pack Control Module detects a problem with reading the current.

Battery Pack Temp:

Displays FAULT when the Battery Pack Control Module detects a fault in the temperature sensing circuitry that cannot be compensated for.

Battery Pack Voltage:

Displays FAULT when the Battery Pack Control Module determines that a number of battery module voltages are incorrect.

Charge Receptacle Over Temp:

Displays FAULT when the Battery Pack Control Module detects an over-temperature condition in the charge receptacle.

Charge Receptacle Temp Circuit:

Represents the charge receptacle has a fault that will prevent charging.

- **OK:** Charge coupler is present, no charge receptacle power supply fault is present.
- **OPEN:** charge receptacle temperature circuit is open OR a charge receptacle power supply fault is present.
- **SHORT:** charge receptacle temperature is shorted.
- **INVALID:** charge receptacle temperature cannot be determined.

Charger Transfer Mode:

- **STANDBY:** Conditions for power transfer have not been met.
- **READY:** Conditions for power transfer have been met. Power transfer control process is active.
- **TRANSFER:** The Battery Pack Control Module is requesting power from the charger.
- **FAULT:** A condition has occurred that is not acceptable for power transfer.

Vehicle Ready:

Displays YES when the charge coupler is inserted into the charge receptacle and the vehicle is in a state that will support charging/preconditioning.

Vehicle Run:

Displays YES when the Battery Pack Control Module receives Run 1.

Charger Communication:

Displays YES when the Battery Pack Control Module receives Class II messages from the charger.

Battery Pack Current Valid:

Displays YES when the Battery Pack Control Module detects current above a certain level.

Code Number:

Represents the Diagnostic Trouble Code (DTC) number of the fault.

Number of Fault Occurrences:

Represents the number of times that the Diagnostic Trouble Code (DTC) has occurred.

Ign. Cycles Since Last DTC:

Represents the number of power cycles since the last time the Diagnostic Trouble Code (DTC) occurred.

Ign. Cycles Since First Fault Code Set:

Represents the number of power cycles since the first time the Diagnostic Trouble Code (DTC) occurred.

Vehicle State:

Represents the operational mode of the vehicle as determined by the Battery Pack Control Module.

- **STANDBY:** Mode not yet determined.
- **CHARGE :** Charging is currently taking place.
- **PROPEL:** Motoring/Regeneration.
- **SUPPORT:** Supporting vehicle operations only.
- **SHUTDOWN:** Functional process shutting down.

Vehicle Run:

Displays YES when the Battery Pack Control Module receives the Run 1.

Park Selected:

Displays YES when the Transmission Range Switch is in Park. This is read by a discrete line to the Battery Pack Control Module from the Transmission Range Switch.

Commanded Battery Pack Fan Speed:

Displays the speed at which the Battery Pack Control Module commands the fan to run. The signal is Pulse Width Modulated (PWM).

Charge Receptacle Temperature:

Displays the temperature of the charge receptacle during charging. the temperature value will read 0°C (32°F) when the charge coupler is not inserted in the charge receptacle.

Charge Receptacle CKT:

Displays YES when the Battery Pack Control Module detects a short in the charge receptacle temperature sensor.

Commanded Auto Disconnect:

Displays the command to the auto disconnect to take action.

- **NORMAL:** The AD may open the relays as required in any fault condition.
- **INHIBIT:** The AD may open the relays in any fault condition except an isolation fault.
- **DISCONNECT:** Command from the Battery Pack Control Module to open the relays.

Auto Disconnect State:

Displays the present state of the auto disconnect.

- **NORMAL:** The relays are closed and battery pack power is available at the Power Inverter Module (PIM).
- **FAIL:** (AD precharge fault) The AD was unsuccessful in precharging the high voltage bus in the required time. The relays are open.
- **COMMANDED:** The Battery Pack Control Module commands AD to open relays.
- **LOOP:** (interlock loop) The AD detects a failure in the interlock loop circuit.
- **PRECHARGE:** The AD is precharging the bus to enable closing of the relays.
- **LOW VOLTAGE:** The AD detects a low battery pack voltage.
- **GROUND:** The AD detects a shift or loss of ground.
- **ISOLATION:** The AD detects a High Voltage (HV) isolation fault.
- **PS FAIL:** (power supply failure) The Battery Pack Control Module detects a failure of the AD power supply.
- **INVALID:** The AD state cannot be determined.

Battery Pack Control Module Periodic Wake-up:

Displays ON when the HTCM has asserted the vehicle wake-up line due to a previous request by the Battery Pack Control Module.

Battery Pack Control Module Periodic Wakeup Multiplier

HTCM uses this value multiplied by 15 to determine the amount of time before the HTCM requests vehicle wake-up.

Propulsion System Status:

Represents the operational mode of the vehicle as determined by the Battery Pack Control Module.

- **STANDBY:** Mode not yet determined.
- **PROPEL:** Motoring/regenerating.
- **CHARGE:** Charging and/or preconditioning.
- **ENDCHG:** Shut down charging.
- **PRECON:** Preconditioning only no charging.
- **SHUTDOWN:** Functional process complete.

Charge Status:

Represents the present or last operational state of charging as determined by the Battery Pack Control Module.

- **RESET:** Reset any charge faults previously detected
- **CHARGING:** Normal charging.
- **FLOATING:** (Float charge) Maintain present charge of the Battery Pack (BP).
- **UPDATING:** Updating the charge status of the BP.
- **EQUALIZING:** Equalization charging.
- **FAULT:** Charging failed due to no control.

True SOC:

Displays the percentage of True State of Charge when the fault occurred. 15% True State of Charge (TSOC) equals 0% User State of Charge (USOC).

Vehicle Speed:

Displays vehicle speed at the time the fault occurred.

Pack Voltage:

Displays the sum of the 26 module voltages as calculated by the Battery Pack Control Module.

Battery Pack:

Displays the current flow when the fault occurred (positive current charges the batteries).

Battery Pack Air Inlet Temp Sensor:

Displays the temperature used for Battery Pack Control Module control purposes.

Accessory Power:

Displays the aux. battery voltage as seen by the Battery Pack Control Module.

Odometer:

Displays the miles at the start of the charging event.

Distance Since Last Charge:

Displays the distance traveled since the last charge event took place.

Cycles Since Last Charge:

Displays the number of power transfer cycles that have occurred since the last time the vehicle was charged.

Charge Terminate Mode:

Displays the reason the Battery Pack Control Module stopped charging.

- **CHARGE:** The vehicle is currently charging.
- **NORMAL:** Charging was completed based on BP current completion criteria.
- **PERCENT:** Charging was completed based on amp hours returned.
- **COUPLER:** Charge coupler was removed before charging was complete.
- **CHARGER FLT:** Charger reported to Battery Pack Control Module that it had a fault.
- **MIN PWR:** Minimum output power from the charger was reached so the Battery Pack Control Module terminated charging.

Equalization Reached During Charge:

Displays YES when the Battery Pack Control Module began/completed equalization (leveling) charging.

Battery Pack Cooling During Charge:

Displays YES when the battery pack (BP) required cooling during charging.

Battery Pack Temp Increase Charge Time:

Displays YES when the charge time was increased based on the temperature of the battery pack during charging.

Battery Power Increase Charge Time:

Displays YES when the charge time was increased based on the available power from the charger.

Base Charge Time:

Displays the time taken to complete base charging. Base charging means no equalization, aux. charging, preconditioning, or vehicle support.

Used Since Last Charge:

Displays the amount of charge used since the last charge occurred.

Returned During Charge:

Displays the amount of charge returned during this charging event.

Max Battery Pack During Charge:

Displays the maximum pack voltage that occurred during this charging event.

Battery Pack End of Charge:

Displays the current that the battery pack received when this charging event ended.

Pack Capability

Displays the present remaining amp-hours (capability) in the battery pack if it was discharged at 25 amps, 27°C (80°F) to a battery module voltage of 10.5 volts.

Pack Capacity

Displays the maximum pack capacity (amp-hours) when fully charged if the pack was discharged at 25 amps, 27°C (80°F) to a battery module voltage of 10.5 volts.

Battery Pack SOC Start of Charge:

Displays the True State of Charge at the start of this charging event. 15% True State of Charge (TSOC) equals 0% User State of Charge (USOC).

Battery Pack SOC End of Charge:

Displays the True State of Charge at the end of this charging event. 15% True State of Charge (TSOC) equals 0% User State of Charge (USOC).

Equalization Percent Complete:

Displays the percentage of equalization completed during this charging event.

Battery Pack Temp Start of Charge:

Displays the temperature value when this charging event started.

Max Battery Pack Temp During Charge:

Displays the maximum temperature value achieved during this charging event.

Charger Min Power:

Displays the minimum output power that the charger design being used can supply.

Charger Max Power:

Displays the maximum output power that the charger design being used can supply.

Software ID 1-4:

Displays the 8-digit charger software ID of the charger used during this charging event.

Code Number:

Represents the Diagnostic Trouble Code (DTC) number of the fault.

Number of Fault Occurrences:

Represents the number of times that the Diagnostic Trouble Code (DTC) has occurred.

Ign. Cycles Since Last DTC:

Represents the number of power transfer cycles since the last time the Diagnostic Trouble Code (DTC) occurred.

Ign. Cycle Since First Fault Code Set:

Represents the number of power transfer cycles since the first time the Diagnostic Trouble Code (DTC) occurred.

Comp Prop Batt:

Displays the compensated voltage for a six cell battery module.

Module Voltage Delta:

Displays the voltage delta between the module indicated and the normalized module voltage. Normalized module voltage equals battery pack voltage divided by 26.

Battery Pack:

Displays the sum of the 26 module voltages as calculated by the Battery Pack Control Module.

Battery Pack:

Displays the current flowing in the battery pack that is used for control purposes. The current is measured at the shunt in the battery pack (positive current equals charging).

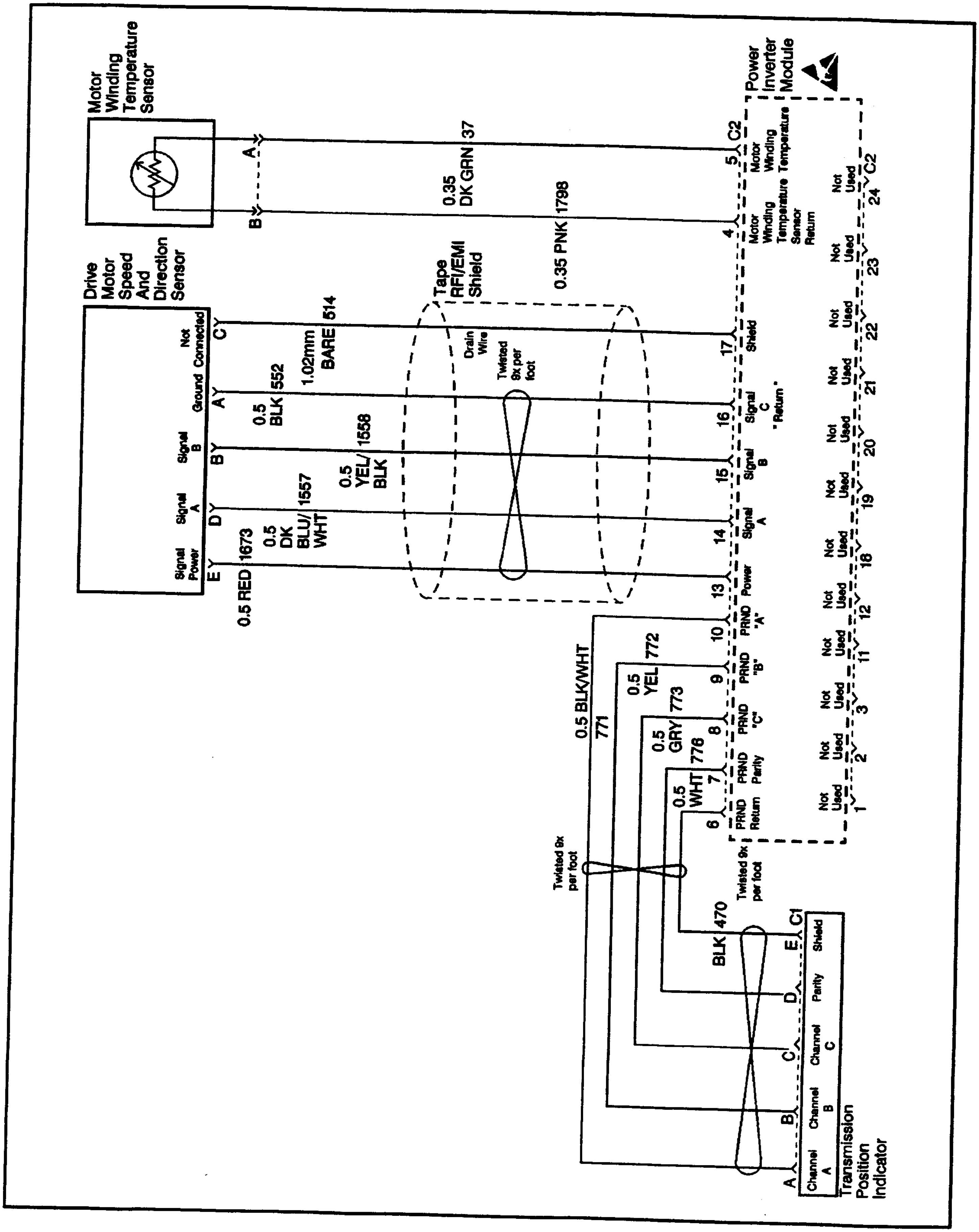
Battery Pack Temp:

Displays the temperature used for Battery Pack Control Module control purposes.

True State of Charge (TSOC):

Displays the percentage of Pack State of Charge when the fault occurred. 15% True State of Charge (TSOC) equals 0% User State of Charge (USOC).

Wiring Diagram - (1 of 16)


Motor Winding Temperature Sensor
A
B
0.35 DK GRN 37
0.35 PNK 1798
C2
5
4
Motor Winding Temperature
Motor Winding Temperature Sensor Return
Power Inverter Module
Drive Motor Speed And Direction Sensor
Not Connected
Ground
Signal B
Signal A
Signal Power
C
A
B
D
E
1.02mm BARE 514
0.5 BLK 552
0.5 YEL/BLK 1558
0.5 DK BLU/WHT 1557
0.5 RED 1673
Tape RFI/EMI Shield
Drain Wire
Twisted 9x per foot
17
16
15
14
13
Shield
Signal C "Return"
Signal B
Signal A
Power
10
9
8
7
6
PRND "A"
PRND "B"
PRND "C"
PRND Parity
PRND Return
0.5 BLK/WHT 771
0.5 YEL 772
0.5 GRY 773
0.5 WHT 776
BLK 470
Twisted 9x per foot
Twisted 9x per foot
Not Used
24
23
22
21
20
19
18
12
11
3
2
1
C1
E
D
C
B
A
Shield
Parity
Channel C
Channel B
Channel A
Transmission Position Indicator

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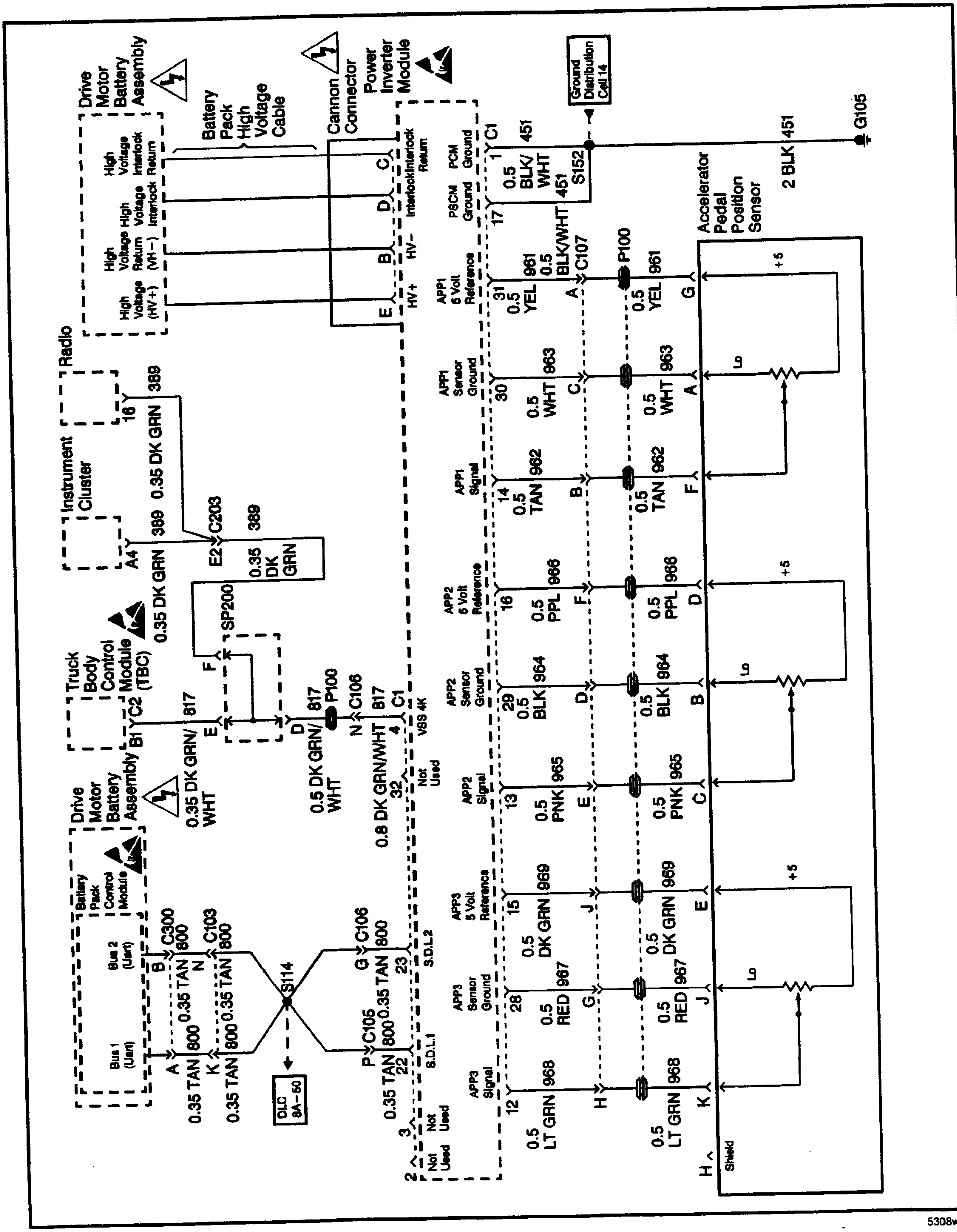
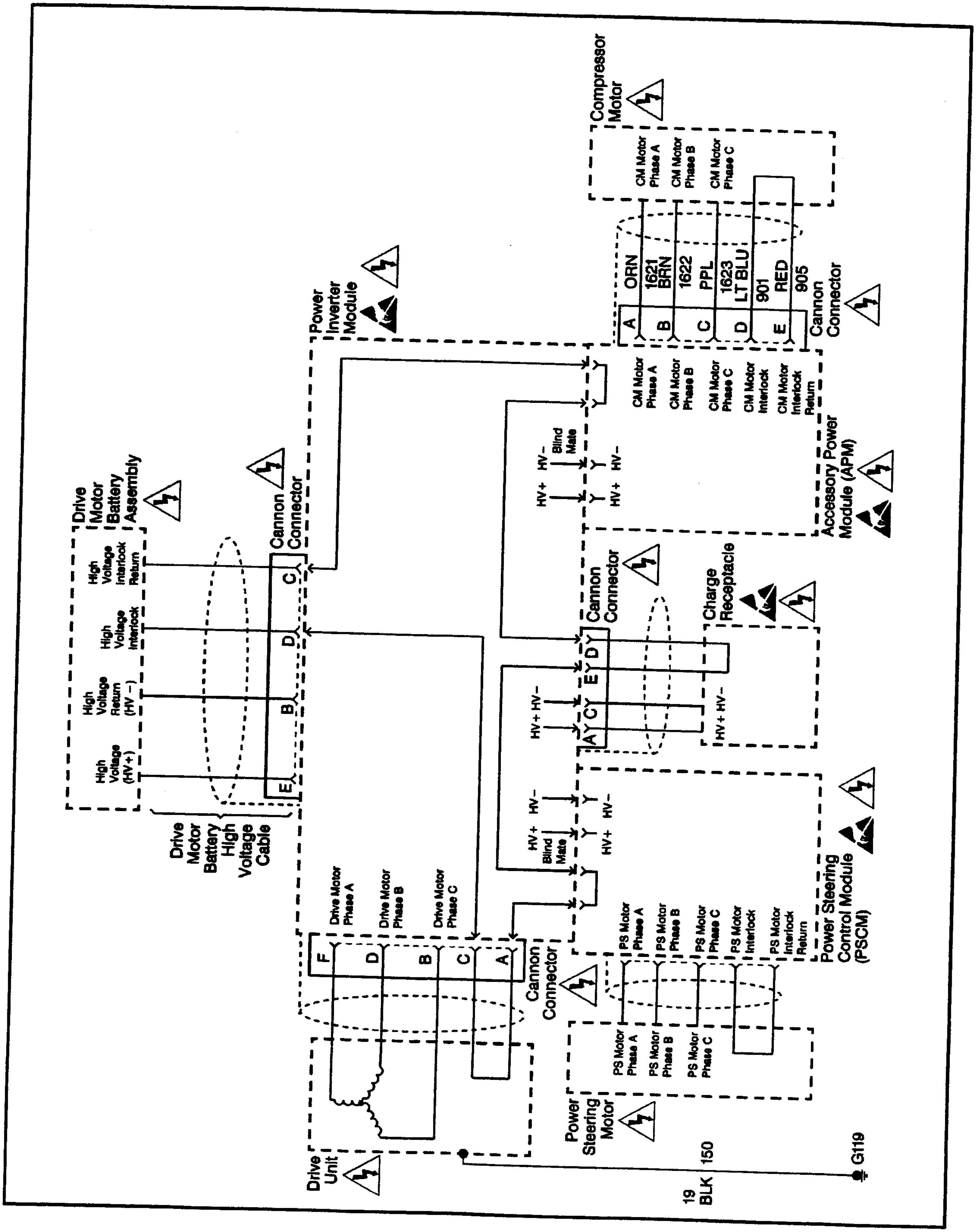
Wiring Diagram - (2 of 16)


Drive Motor Battery Assembly
Battery Pack High Voltage Cable
Cannon Connector
Power Inverter Module
Ground Distribution Cell 14
G105
S152
2 BLK 451
0.5 BLK/WHT 451
PCM Ground
PSCM Ground
High Voltage Interlock Return
High Voltage Interlock
High Voltage Return (VH−)
High Voltage (HV+)
Interlock Interlock Return
HV− HV+
Radio
Instrument Cluster
389 0.35 DK GRN
C203
Truck Body Control Module (TBC)
SP200
0.35 DK GRN/WHT 817
0.5 DK GRN/WHT 817
P100
C106
0.8 DK GRN/WHT 817
VSS 4K
Not Used
Battery Pack Control Module
Bus 1 (Uart)
Bus 2 (Uart)
C300
C103
C105
S114
0.35 TAN 800
DLC 8A-50
S.D.L.1
S.D.L.2
APP1 5 Volt Reference
APP1 Sensor Ground
APP1 Signal
APP2 5 Volt Reference
APP2 Sensor Ground
APP2 Signal
APP3 5 Volt Reference
APP3 Sensor Ground
APP3 Signal
0.5 YEL 961
0.5 WHT 963
0.5 TAN 962
0.5 PPL 966
0.5 BLK 964
0.5 PNK 965
0.5 DK GRN 969
0.5 RED 967
0.5 LT GRN 968
C107
Accelerator Pedal Position Sensor
+5
Lo
Shield

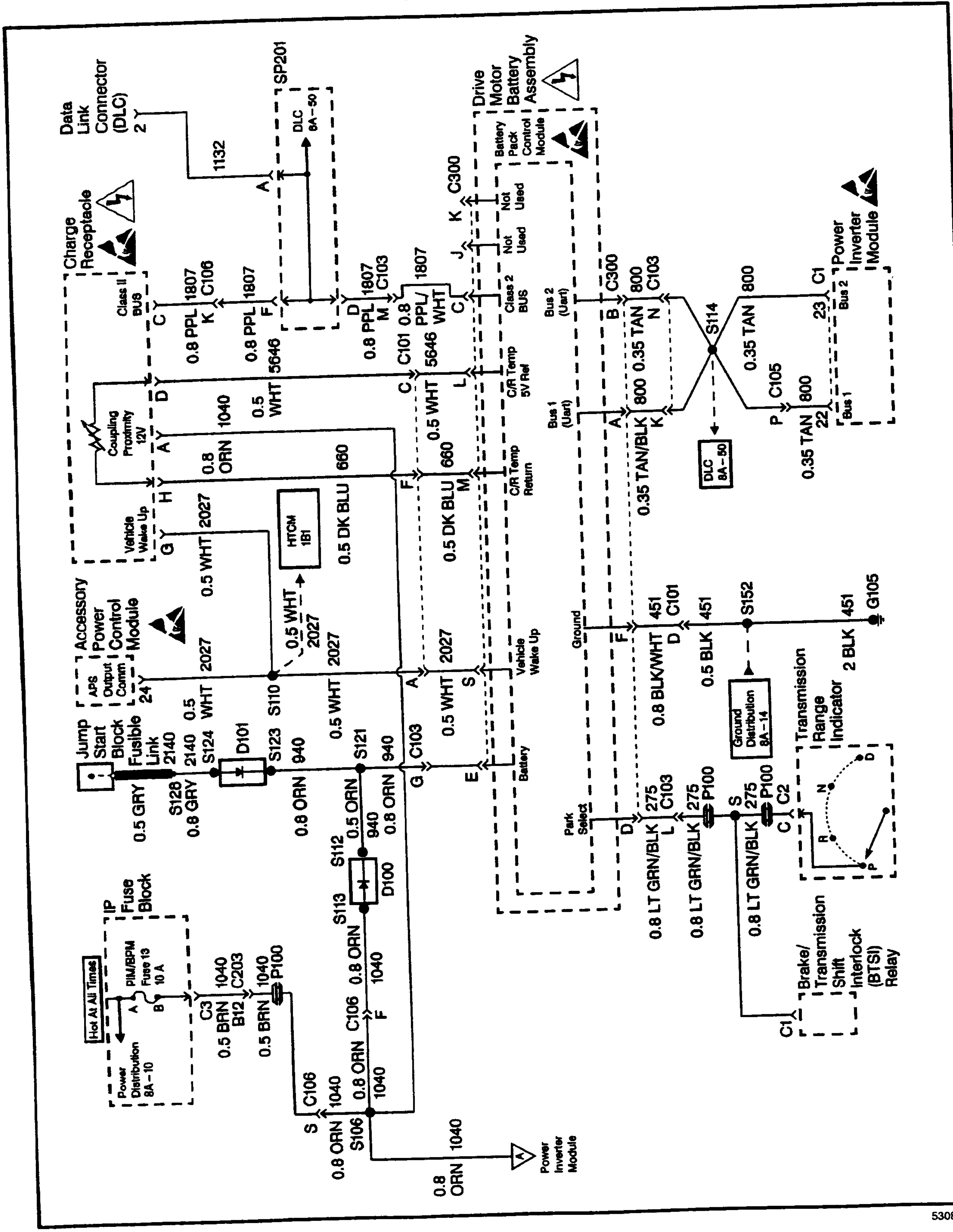
5308w2452

Wiring Diagram - (3 of 16)


Drive Motor Battery Assembly
High Voltage Interlock Return
High Voltage Interlock
High Voltage Return (HV –)
High Voltage (HV+)
Cannon Connector
C
D
B
E
Drive Motor Battery High Voltage Cable
Power Inverter Module
Compressor Motor
CM Motor Phase A
CM Motor Phase B
CM Motor Phase C
ORN
1621 BRN
1622 PPL
1623 LT BLU
901 RED
905
A
B
C
D
E
Cannon Connector
CM Motor Phase A
CM Motor Phase B
CM Motor Phase C
CM Motor Interlock
CM Motor Interlock Return
HV+
HV –
Blind Mate
HV+
HV –
Accessory Power Module (APM)
Cannon Connector
D
E
C
A
HV+
HV–
Charge Receptacle
HV+
HV–
HV+
HV–
Blind Mate
HV+
HV–
Power Steering Control Module (PSCM)
PS Motor Phase A
PS Motor Phase B
PS Motor Phase C
PS Motor Interlock
PS Motor Interlock Return
Power Steering Motor
PS Motor Phase A
PS Motor Phase B
PS Motor Phase C
Drive Motor Phase A
Drive Motor Phase B
Drive Motor Phase C
F
D
B
C
A
Cannon Connector
Drive Unit
19
BLK
150
G119

5308v7293

Wiring Diagram - (4 of 16)


Data Link Connector (DLC)
2
1132
A
SP201
DLC 8A-50
Charge Receptacle
Class II BUS
C
0.8 PPL
1807
K
C106
0.8 PPL
1807
F
D
0.8 PPL
1807
M
C103
0.8 PPL/WHT
1807
C
Class 2 BUS
Drive Motor Battery Assembly
Battery Pack Control Module
C300
K
J
Not Used
Not Used
Coupling Proximity 12V
D
0.5 WHT
5646
C101
5646
C
0.5 WHT
L
C/R Temp 5V Ref
A
0.8 ORN
1040
H
660
0.5 DK BLU
F
660
0.5 DK BLU
M
C/R Temp Return
Vehicle Wake Up
G
0.5 WHT
2027
HTCM 1B1
Accessory Power Control Module
APS Output Comm
24
2027
0.5 WHT
2027
S110
0.5 WHT
2027
A
2027
0.5 WHT
S
Vehicle Wake Up
Jump Start Block Fusible Link
2140
0.5 GRY
S128
0.8 GRY
2140
S124
D101
S123
940
0.8 ORN
S121
0.5 WHT
940
0.8 ORN
G
C103
E
Battery
S112
0.5 ORN
940
0.8 ORN
D100
S113
IP Fuse Block
Hot At All Times
Power Distribution 8A-10
PIM/BPM Fuse 13 10 A
A
B
C3
1040
C203
0.5 BRN
B12
0.5 BRN
1040
P100
C106
1040
S
0.8 ORN
S106
C106
0.8 ORN
F
1040
0.8 ORN
1040
A
Power Inverter Module
0.8 ORN
Bus 2 (Uart)
B
C300
800
C103
0.35 TAN
N
S114
800
0.35 TAN
23
C1
Bus 2
Power Inverter Module
Bus 1 (Uart)
A
800
0.35 TAN/BLK
K
C105
P
800
0.35 TAN
22
Bus 1
DLC 8A-50
Ground
F
451
C101
0.8 BLK/WHT
D
451
0.5 BLK
S152
451
2 BLK
G105
Ground Distribution 8A-14
Park Select
D
275
C103
0.8 LT GRN/BLK
L
275
P100
0.8 LT GRN/BLK
S
275
P100
C2
0.8 LT GRN/BLK
C
Transmission Range Indicator
P
R
N
D
Brake/Transmission Shift Interlock (BTSI) Relay
C1

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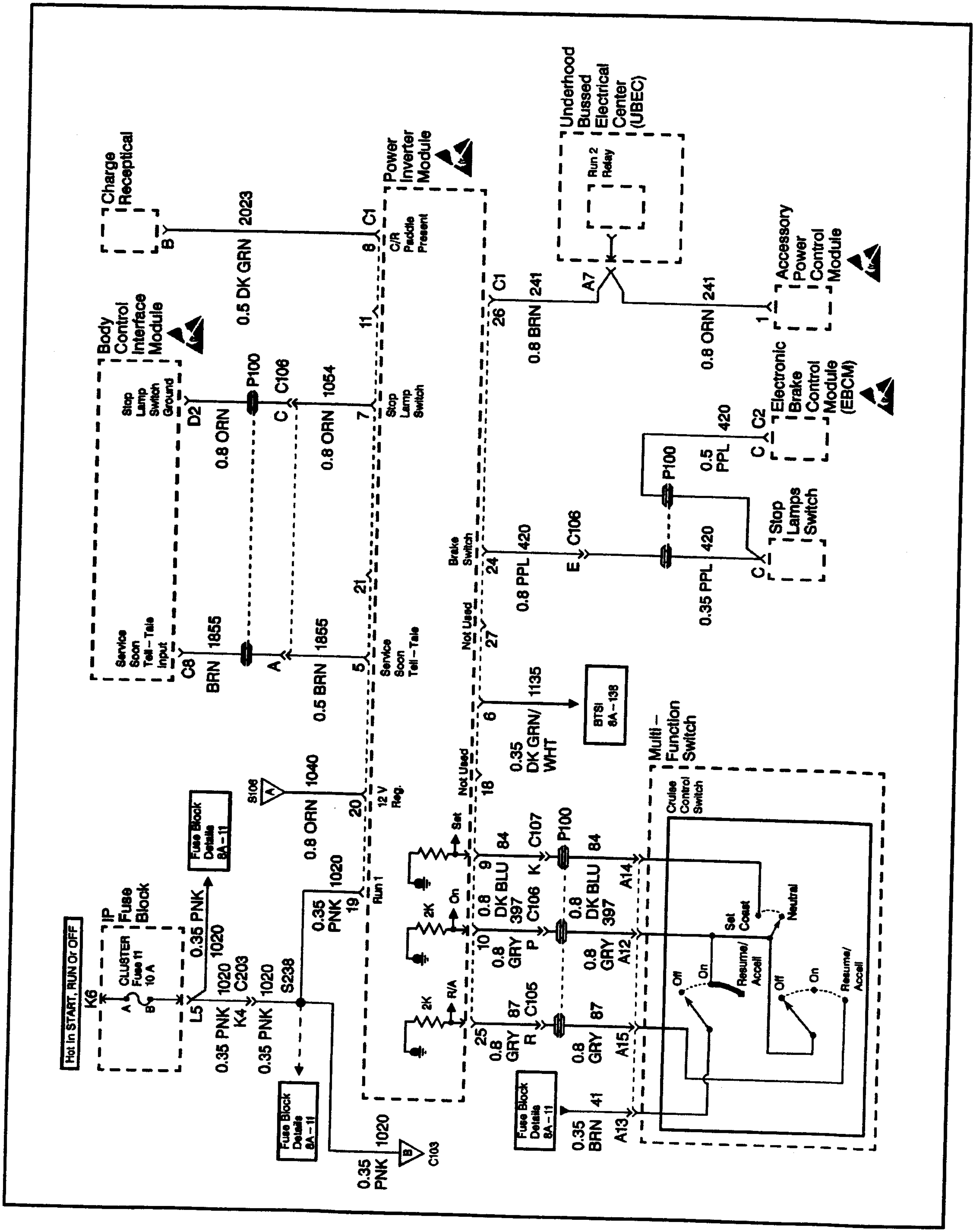
Wiring Diagram - (5 of 16)


Hot In START, RUN Or OFF
IP Fuse Block
CLUSTER Fuse 11 10 A
K6
A
B
L5
0.35 PNK 1020
Fuse Block Details 8A-11
0.35 PNK 1020 K4 C203
0.35 PNK 1020 S238
Fuse Block Details 8A-11
0.35 PNK 1020
B C103
S108 A
0.8 ORN 1040
0.35 PNK 1020
19 Run 1
20 12 V Reg.
Body Control Interface Module
Service Soon Tell-Tale Input
C8 BRN 1855
Stop Lamp Switch Ground
D2 0.8 ORN
P100
C C106
A
0.5 BRN 1855
5 Service Soon Tell-Tale
21
0.8 ORN 1054
7 Stop Lamp Switch
11
Charge Receptical
B
0.5 DK GRN 2023
C1 8 C/R Paddle Present
Power Inverter Module
Not Used 18
6
0.35 DK GRN/WHT 1135
BTSI 8A-138
Not Used 27
Brake Switch 24
0.8 PPL 420
E C106
0.35 PPL 420
C
Stop Lamps Switch
P100
0.5 PPL 420
C C2
Electronic Brake Control Module (EBCM)
26 C1
0.8 BRN 241
A7
Underhood Bussed Electrical Center (UBEC)
Run 2 Relay
0.8 ORN 241
1
Accessory Power Control Module
Set
On
R/A
2K
2K
2K
9 0.8 DK BLU 84 C107 K
10 0.8 DK BLU 397 C106 P
25 0.8 GRY 87 C105 R
0.8 GRY
P100
84 A14
0.8 DK BLU 397 A12
0.8 GRY 87 A15
0.8 GRY
Fuse Block Details 8A-11
0.35 BRN 41 A13
Multi-Function Switch
Cruise Control Switch
Set Coast
Neutral
Off
On
Resume/Accel
Off
On
Resume/Accel

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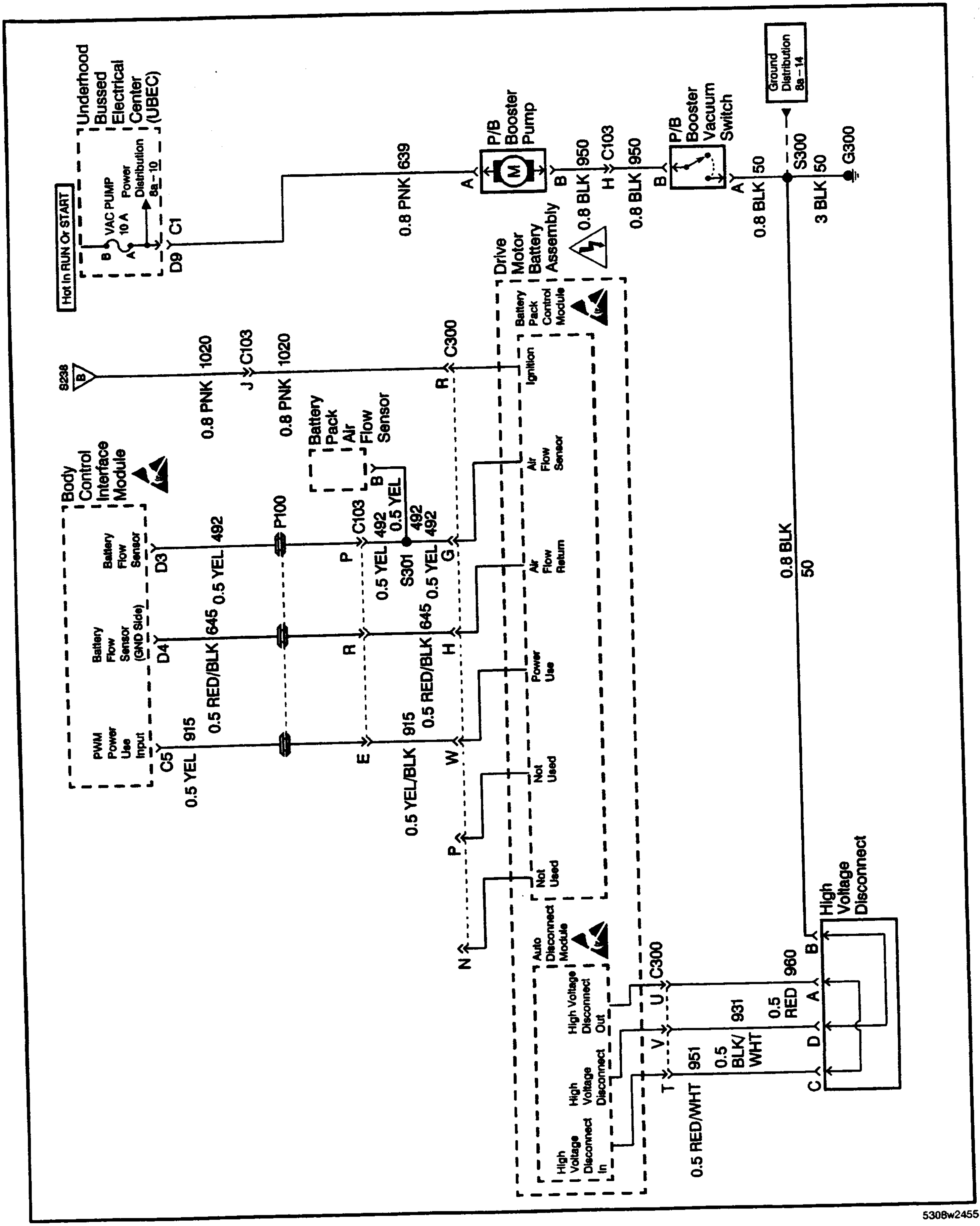
Wiring Diagram - (6 of 16)


Hot In RUN Or START
Underhood Bussed Electrical Center (UBEC)
VAC PUMP 10 A
Power Distribution 8a-10
B
A
D9
C1
0.8 PNK 639
A
P/B Booster Pump
M
B 950
H C103 950
0.8 BLK
0.8 BLK
P/B Booster Vacuum Switch
B
A 50
0.8 BLK
S300
50
3 BLK
G300
Ground Distribution 8a-14
Drive Motor Battery Assembly
Battery Pack Control Module
S238
B
0.8 PNK 1020
J C103
0.8 PNK 1020
R C300
Ignition
Battery Pack Air Flow Sensor
B
0.5 YEL
492
Air Flow Sensor
Body Control Interface Module
Battery Flow Sensor
D3
0.5 YEL 492
P100
P C103
492
0.5 YEL
S301
0.5 YEL
G
Air Flow Return
Battery Flow Sensor (GND Side)
D4
0.5 RED/BLK 645
R
645
0.5 RED/BLK
H
Power Use
PWM Power Use Input
C5
0.5 YEL 915
E
915
0.5 YEL/BLK
W
Not Used
P
Not Used
N
Auto Disconnect Module
High Voltage Disconnect Out
High Voltage Disconnect
High Voltage Disconnect In
C300
U
V
T
0.5 RED/WHT
951
0.5 BLK/WHT
931
0.5 RED
960
0.8 BLK
50
High Voltage Disconnect
B
A
D
C

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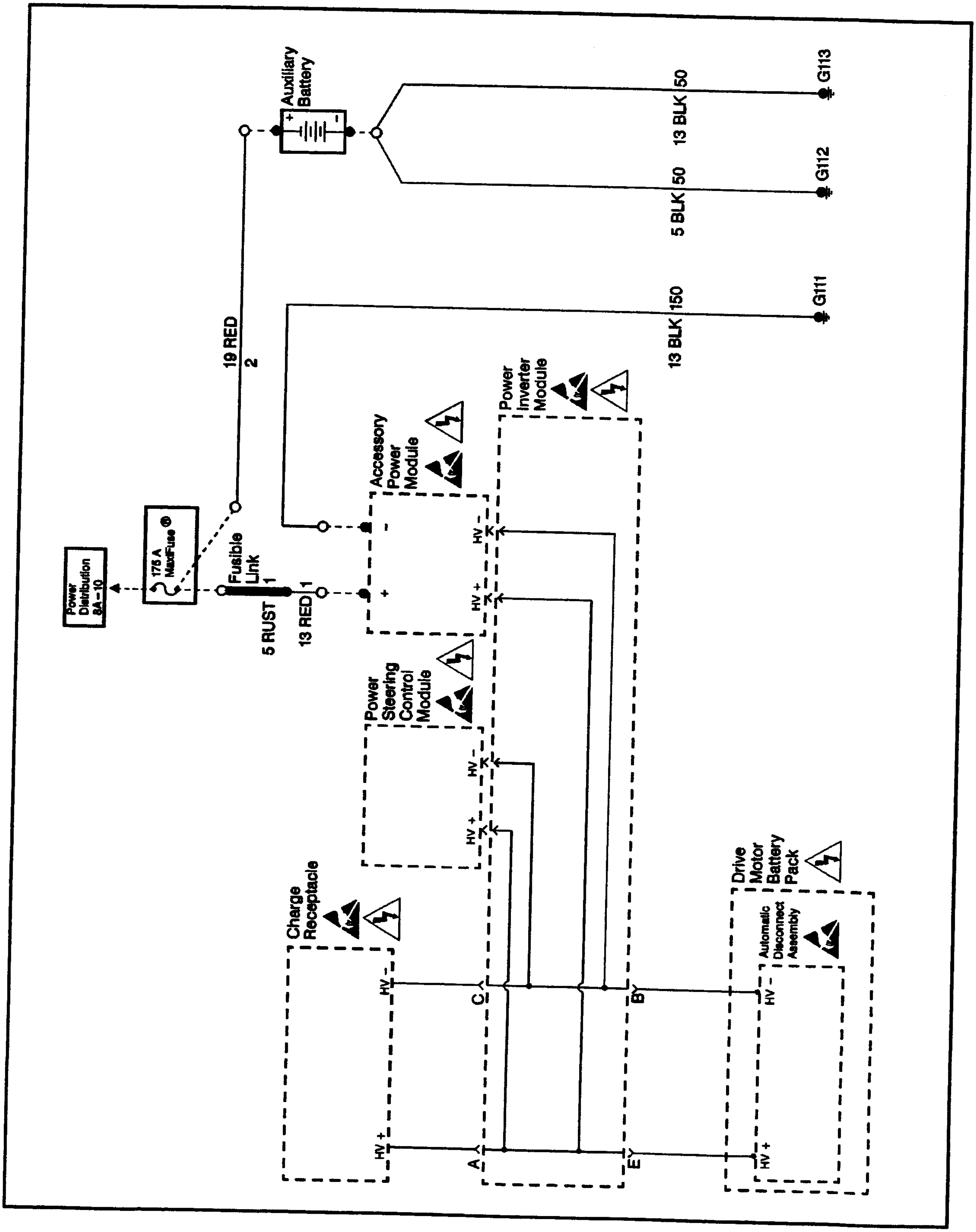
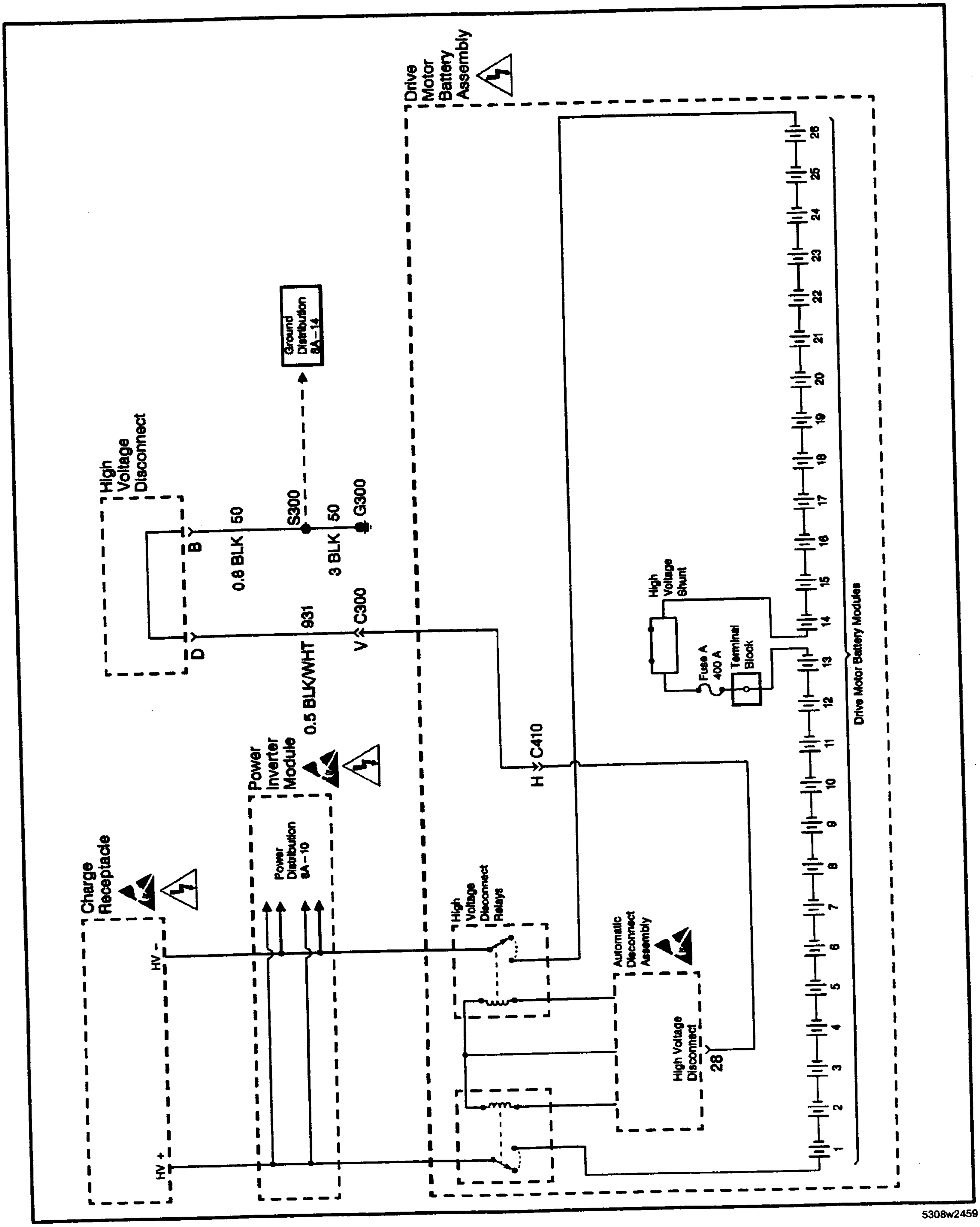
Wiring Diagram - (7 of 16)


Auxiliary Battery
+
-
13 BLK
50
G113
5 BLK
50
G112
13 BLK
150
G111
19 RED
2
Power Inverter Module
Accessory Power Module
-
+
HV -
HV +
Power Distribution 8A-10
175 A MaxiFuse ®
Fusible Link
1
5 RUST
13 RED
1
Power Steering Control Module
HV -
HV +
Charge Receptacle
HV -
HV +
C
A
B
E
Drive Motor Battery Pack
Automatic Disconnect Assembly
HV -
HV +

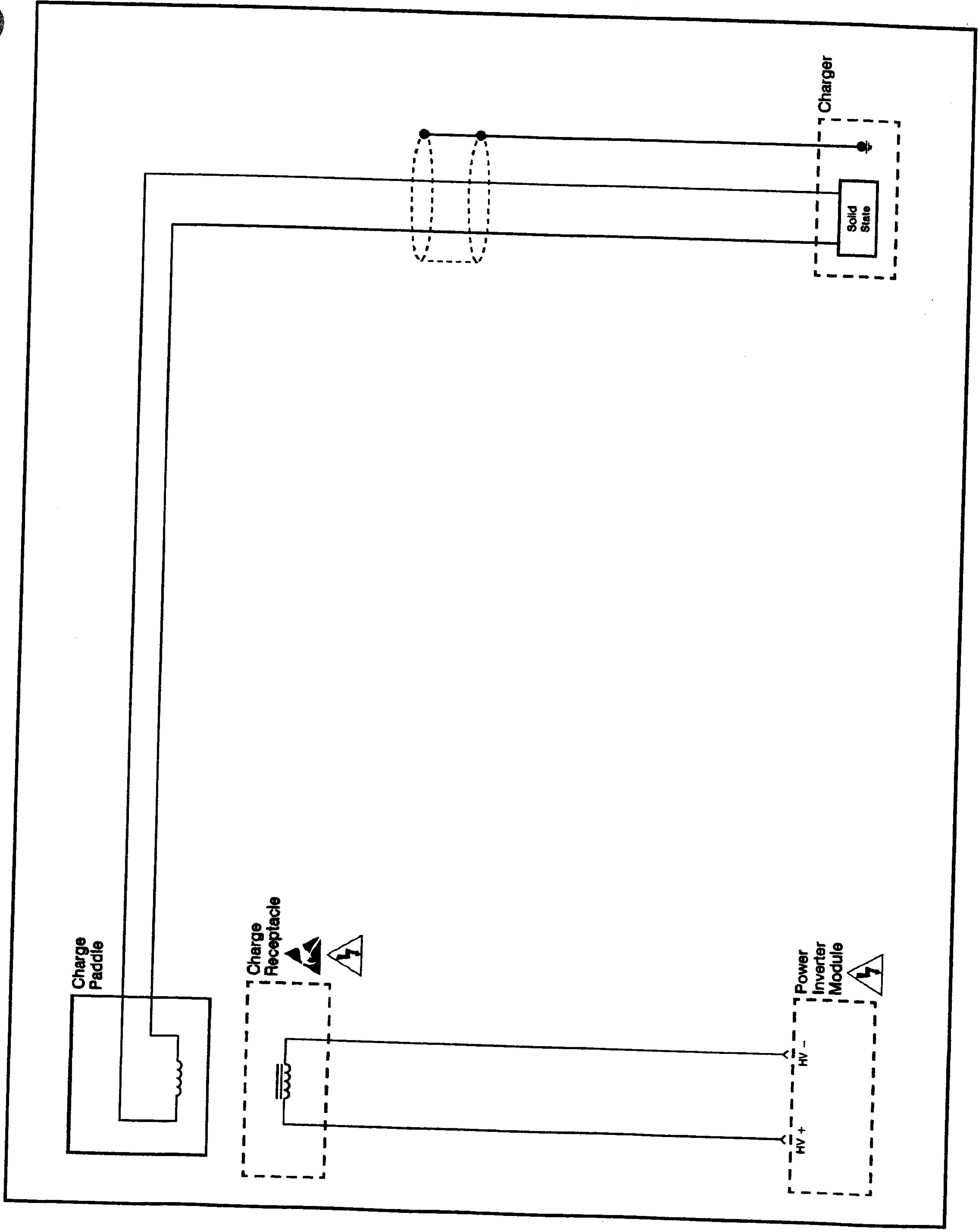
5308w2458

Wiring Diagram - (8 of 16)


Drive Motor Battery Assembly
High Voltage Disconnect
Ground Distribution 8A-14
B
D
0.8 BLK
50
S300
3 BLK
50
G300
0.5 BLK/WHT
931
V
C300
Power Inverter Module
Power Distribution 8A-10
Charge Receptacle
HV -
HV +
H
C410
High Voltage Disconnect Relays
Automatic Disconnect Assembly
High Voltage Disconnect
28
High Voltage Shunt
Fuse A 400 A
Terminal Block
Drive Motor Battery Modules
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26

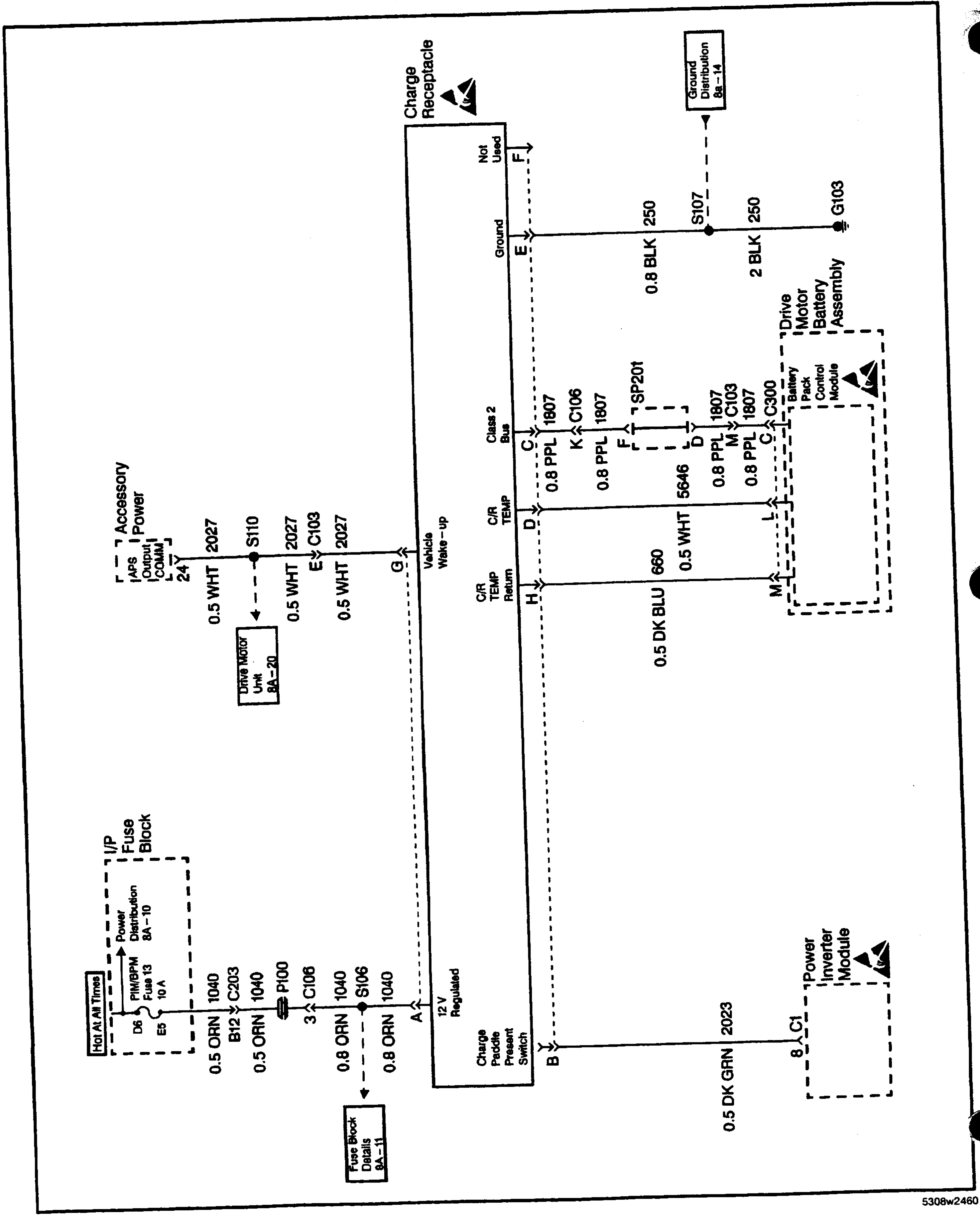
5308w2459

Wiring Diagram - (9 of 16)


Charger
Solid State
Charge Paddle
Charge Receptacle
Power Inverter Module
HV –
HV +

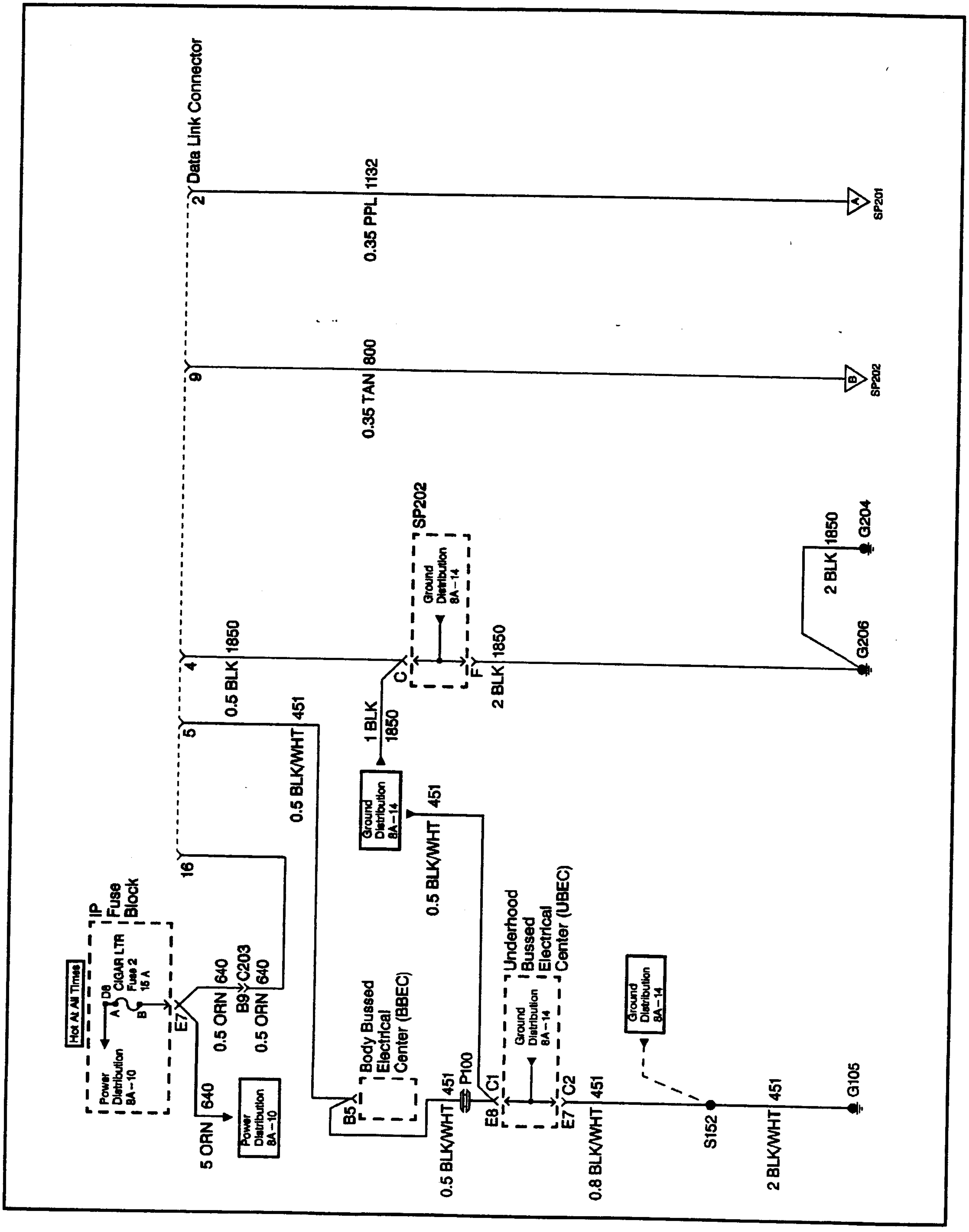
5308v7420

Wiring Diagram - (10 of 16)


Charge Receptacle
Not Used
F
Ground
E
Class 2 Bus
C
C/R TEMP
D
C/R TEMP Return
H
Vehicle Wake-up
G
12 V Regulated
A
Charge Paddle Present Switch
B
Ground Distribution 8a-14
S107
250
0.8 BLK
250
2 BLK
G103
Drive Motor Battery Assembly
Battery Pack Control Module
1807
0.8 PPL
K
C106
1807
0.8 PPL
SP201
F
D
1807
0.8 PPL
M
C103
1807
0.8 PPL
C
C300
5646
0.5 WHT
L
660
0.5 DK BLU
M
Accessory Power
APS Output COMM
24
2027
0.5 WHT
S110
2027
0.5 WHT
E
C103
2027
0.5 WHT
Drive Motor Unit 8A-20
I/P Fuse Block
Hot At All Times
Power Distribution 8A-10
D6
PIM/BPM Fuse 13 10 A
E5
1040
0.5 ORN
B12
C203
1040
0.5 ORN
P100
3
C106
1040
0.8 ORN
S106
1040
0.8 ORN
Fuse Block Details 8A-11
Power Inverter Module
C1
2023
0.5 DK GRN
8

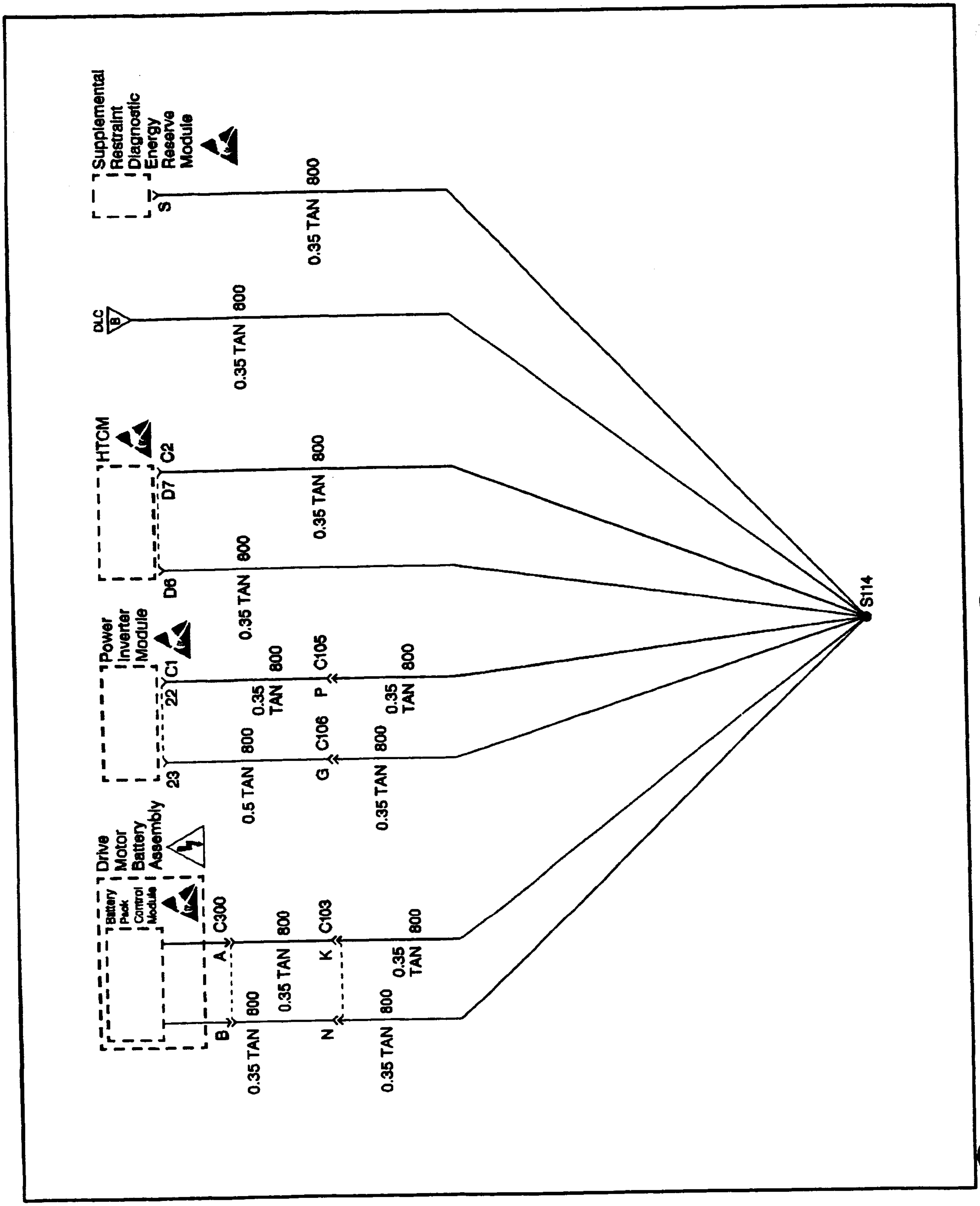
5308w2460

Wiring Diagram - (11 of 16)


Data Link Connector
2
0.35 PPL
1132
SP201
A
9
0.35 TAN
800
SP202
B
4
0.5 BLK
1850
5
0.5 BLK/WHT
451
16
SP202
Ground Distribution 8A-14
C
F
2 BLK
1850
1 BLK
1850
Ground Distribution 8A-14
2 BLK
1850
G204
G206
0.5 BLK/WHT
451
Hot At All Times
IP Fuse Block
D8
CIGAR LTR
Fuse 2
15 A
A
B
Power Distribution 8A-10
E7
0.5 ORN
640
B9
C203
0.5 ORN
640
5 ORN
640
Power Distribution 8A-10
Body Bussed Electrical Center (BBEC)
B5
0.5 BLK/WHT
451
P100
E8
C1
Underhood Bussed Electrical Center (UBEC)
Ground Distribution 8A-14
C2
E7
0.8 BLK/WHT
451
Ground Distribution 8A-14
S152
2 BLK/WHT
451
G105

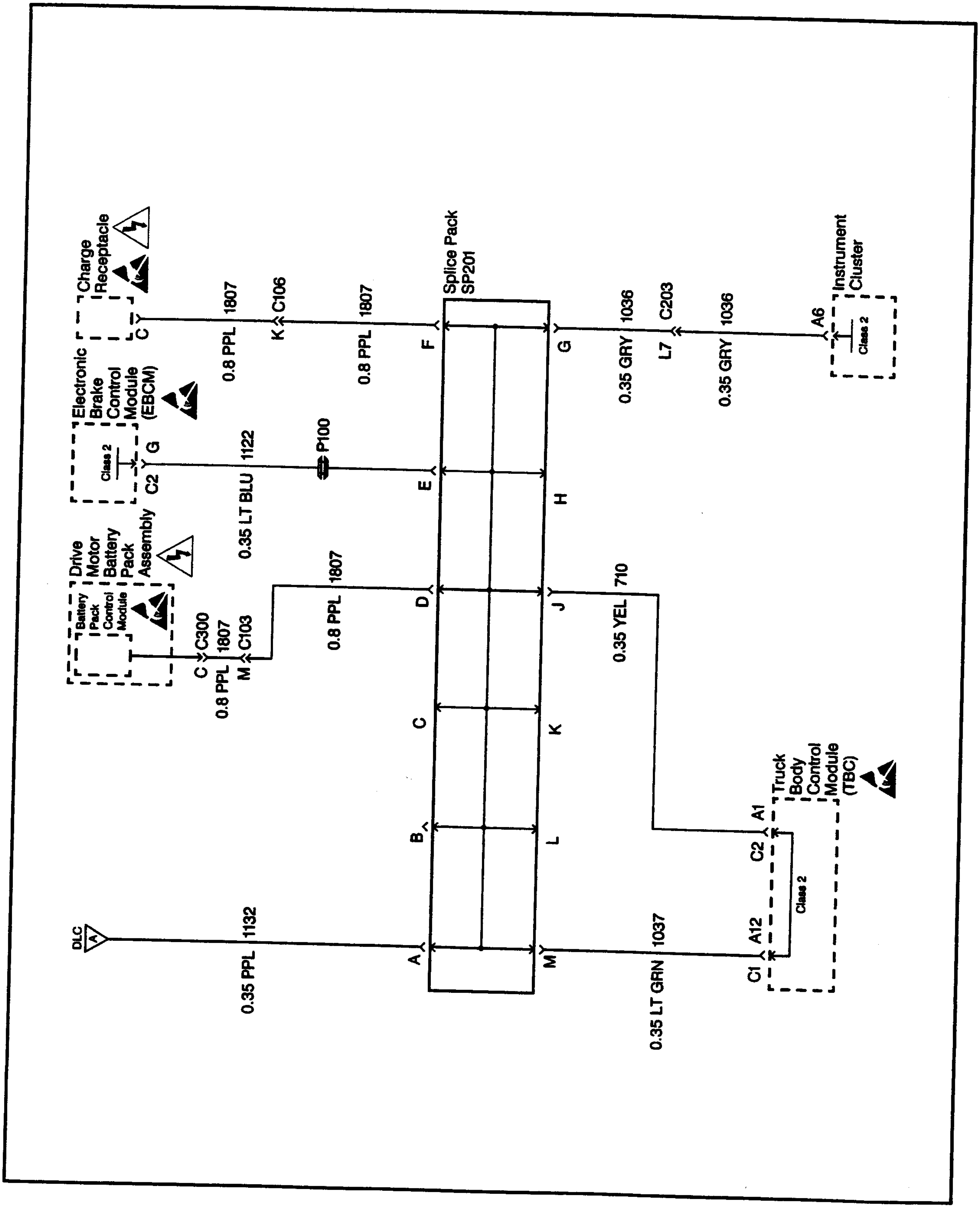
5308w2464

Wiring Diagram - (12 of 16)


Supplemental Restraint Diagnostic Energy Reserve Module
S
0.35 TAN 800
DLC
B
0.35 TAN 800
HTCM
C2
D7
0.35 TAN 800
D6
0.35 TAN 800
Power Inverter Module
C1
22
0.35 TAN 800
C105
P
0.35 TAN 800
23
0.5 TAN 800
C106
G
0.35 TAN 800
Drive Motor Battery Assembly
Battery Pack Control Module
C300
A
0.35 TAN 800
C103
K
0.35 TAN 800
B
0.35 TAN 800
N
0.35 TAN 800
S114

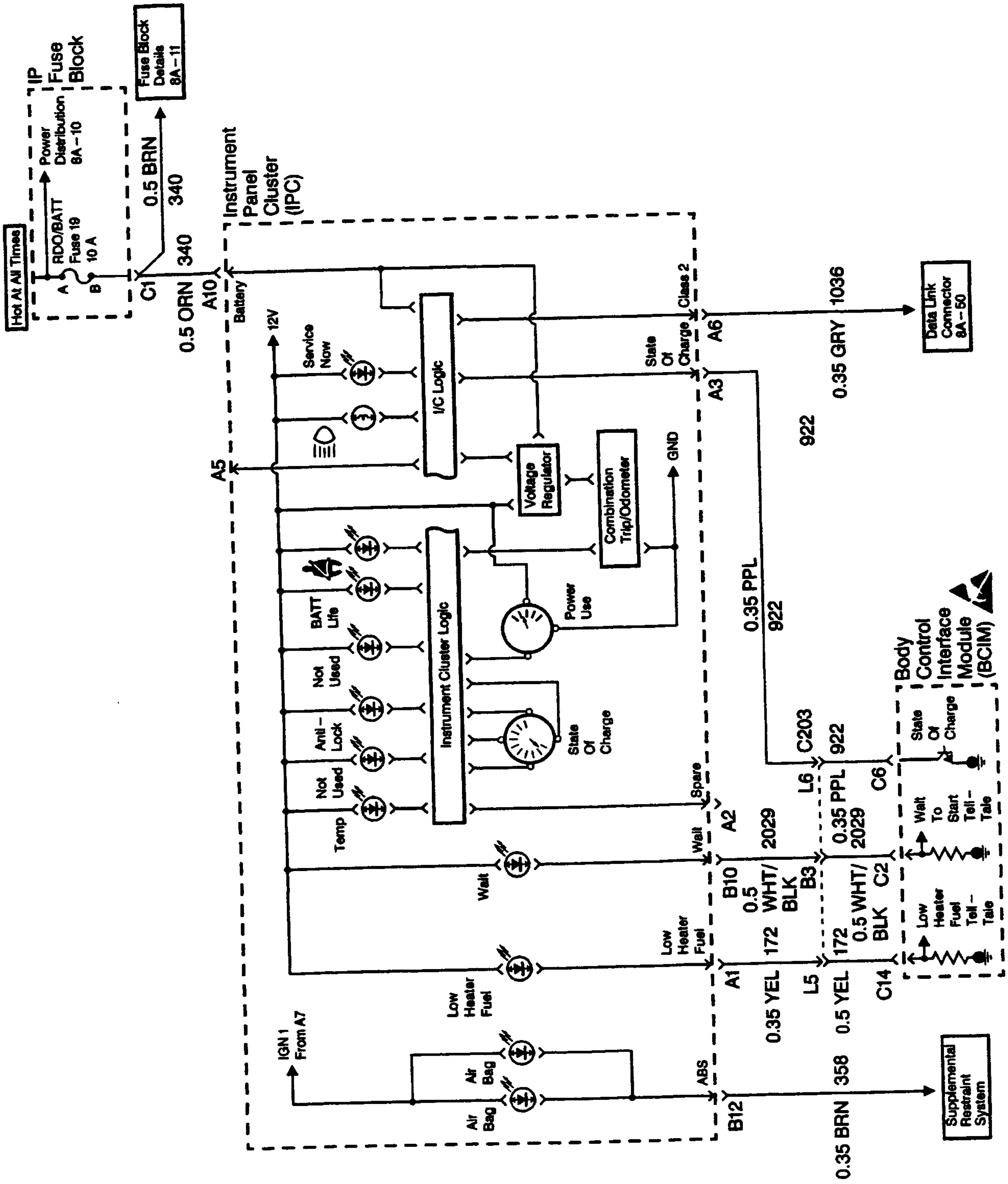
5308w2466

Wiring Diagram - (13 of 16)


Charge Receptacle
C
0.8 PPL
1807
K
C106
0.8 PPL
1807
F
Splice Pack SP201
G
0.35 GRY
1036
L7
C203
0.35 GRY
1036
A6
Instrument Cluster
Class 2
Electronic Brake Control Module (EBCM)
Class 2
C2
G
0.35 LT BLU
1122
P100
E
H
Drive Motor Battery Pack Assembly
Battery Pack Control Module
C
C300
0.8 PPL
1807
M
C103
0.8 PPL
1807
D
J
0.35 YEL
710
C
K
B
L
Truck Body Control Module (TBC)
A1
C2
Class 2
A12
C1
DLC
A
0.35 PPL
1132
A
M
0.35 LT GRN
1037

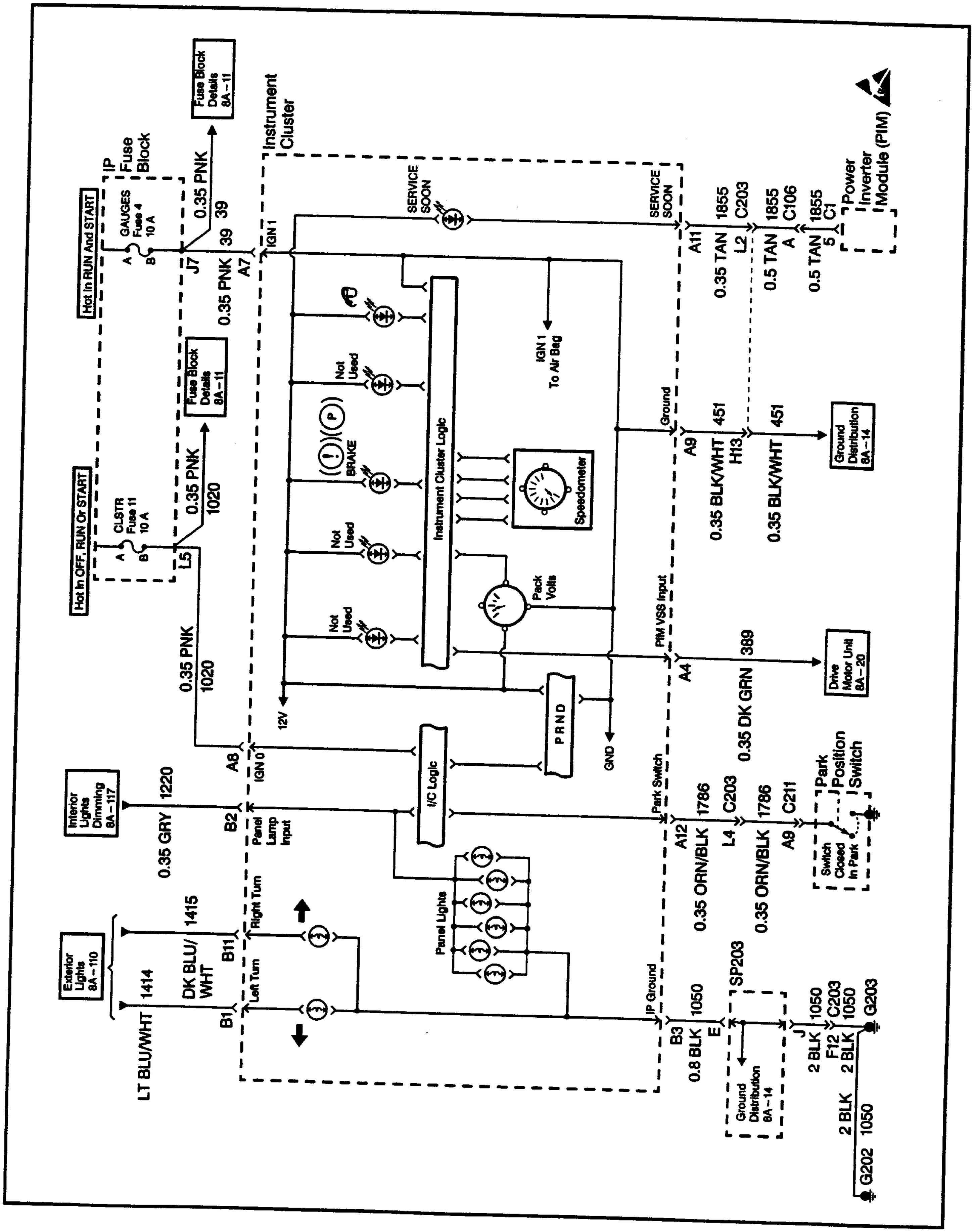
5308w2465

Wiring Diagram - (14 of 16)


Hot At All Times
IP Fuse Block
RDO/BATT
Fuse 19
10 A
A
B
Power Distribution 8A-10
Fuse Block Details 8A-11
C1
0.5 BRN
340
340
0.5 ORN
A10
Instrument Panel Cluster (IPC)
Battery
12V
Service Now
I/C Logic
Class 2
State Of Charge
A6
A3
1036
0.35 GRY
Data Link Connector 8A-50
922
A5
Voltage Regulator
Combination Trip/Odometer
GND
Power Use
BATT Life
Not Used
Anti-Lock
Not Used
Temp
Instrument Cluster Logic
State Of Charge
Spare
A2
0.35 PPL
922
C203
L6
922
0.35 PPL
2029
C6
Body Control Interface Module (BCIM)
State Of Charge
Wait To Start Tell-Tale
Wait
Wait
B10
0.5 WHT/ BLK
2029
B3
0.5 WHT/ BLK
C2
Low Heater Fuel Tell-Tale
Low Heater Fuel
Low Heater Fuel
A1
172
172
L5
0.35 YEL
0.5 YEL
C14
IGN 1 From A7
Air Bag
Air Bag
ABS
B12
358
0.35 BRN
Supplemental Restraint System

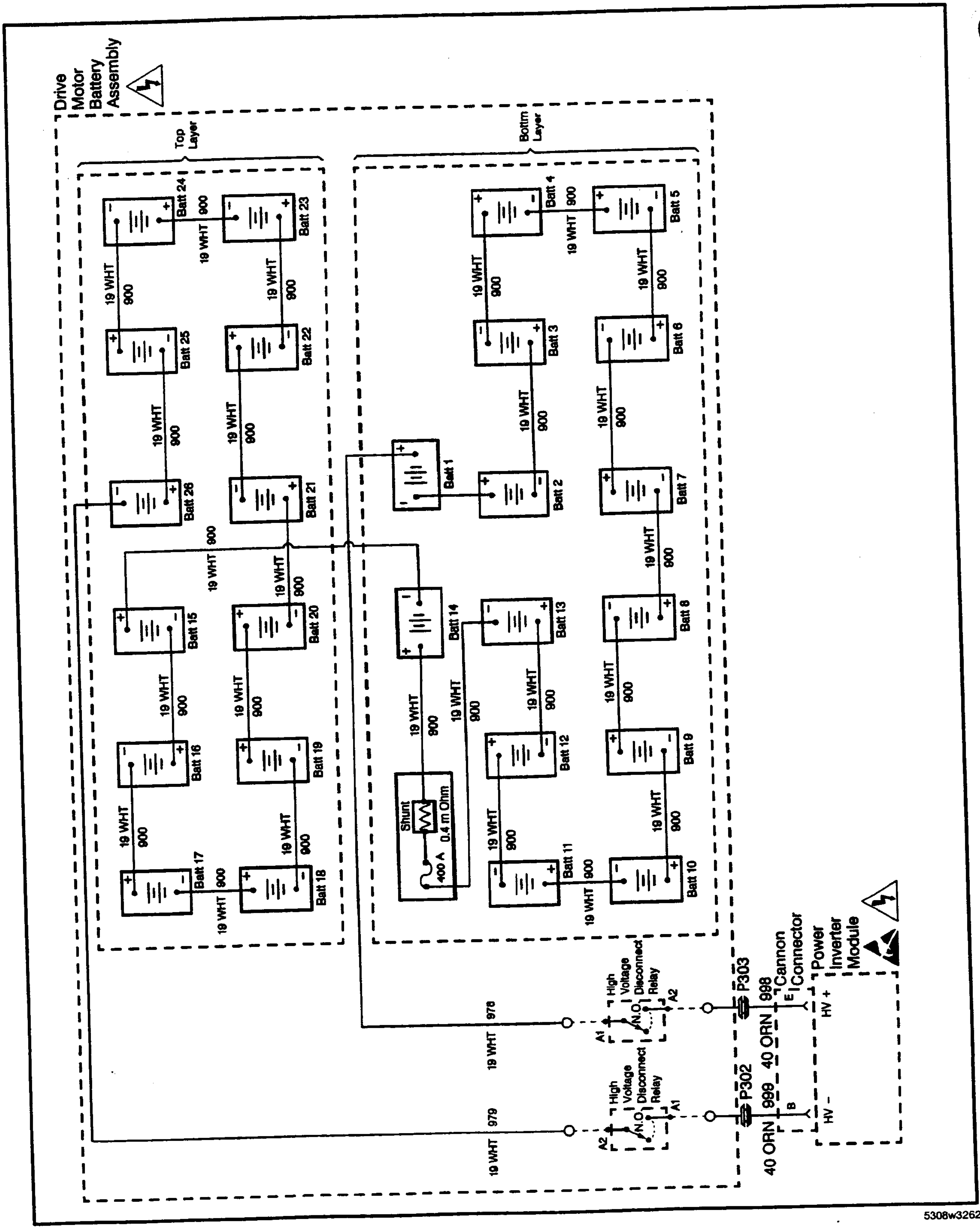
5308w2491

Wiring Diagram - (15 of 16)


Hot In RUN And START
IP Fuse Block
GAUGES Fuse 4 10 A
A
B
J7
0.35 PNK
39
Fuse Block Details 8A-11
Hot In OFF, RUN Or START
CLSTR Fuse 11 10 A
L5
0.35 PNK
1020
Instrument Cluster
A7
IGN 1
SERVICE SOON
Not Used
BRAKE
Instrument Cluster Logic
Speedometer
Pack Volts
IGN 1 To Air Bag
12V
GND
PRND
A8
IGN 0
I/C Logic
Interior Lights Dimming 8A-117
0.35 GRY
1220
B2
Panel Lamp Input
Panel Lights
Exterior Lights 8A-110
1415
DK BLU/WHT
B11
Right Turn
1414
LT BLU/WHT
B1
Left Turn
A11
1855
0.35 TAN
L2
C203
0.5 TAN
C106
C1
5
Power Inverter Module (PIM)
Ground
A9
451
0.35 BLK/WHT
H13
Ground Distribution 8A-14
PIM VSS Input
A4
389
0.35 DK GRN
Drive Motor Unit 8A-20
Park Switch
A12
1786
0.35 ORN/BLK
L4
C211
Park Position Switch
Switch Closed In Park
IP Ground
B3
1050
0.8 BLK
E
SP203
J
2 BLK
F12
G203
G202

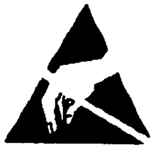
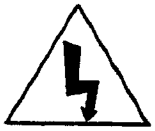
5308w2492

Wiring Diagram - (16 of 16)

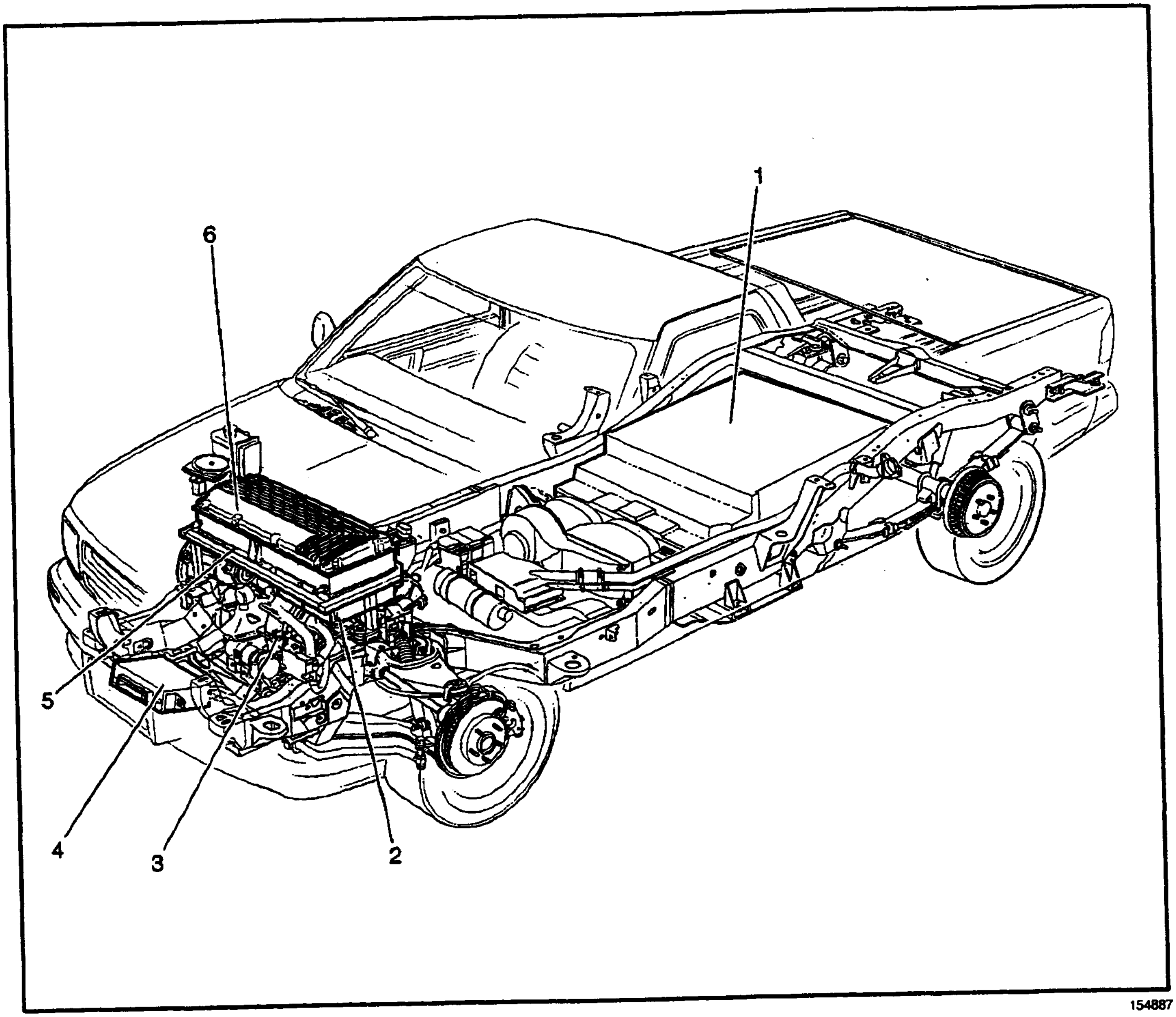

Drive Motor Battery Assembly
Top Layer
Bottm Layer
Batt 1
Batt 2
Batt 3
Batt 4
Batt 5
Batt 6
Batt 7
Batt 8
Batt 9
Batt 10
Batt 11
Batt 12
Batt 13
Batt 14
Batt 15
Batt 16
Batt 17
Batt 18
Batt 19
Batt 20
Batt 21
Batt 22
Batt 23
Batt 24
Batt 25
Batt 26
19 WHT
900
Shunt
0.4 m Ohm
400 A
High Voltage Disconnect Relay
N.O.
A1
A2
978
979
19 WHT
P303
P302
998
999
40 ORN
E
B
Cannon Connector
Power Inverter Module
HV +
HV -

5308w3262

Schematic Icon Reference Table

Icon	Icon Definition
	Refer to Electrostatic Discharge (ESD) Sensitive Devices in Symbols, Page 8A – 3 – 0.
	This Icon is used to alert the technician. The circuits shown with this icon on the schematic contain high voltage. Refer to the *High Voltage Power System* caution in *General Information.*

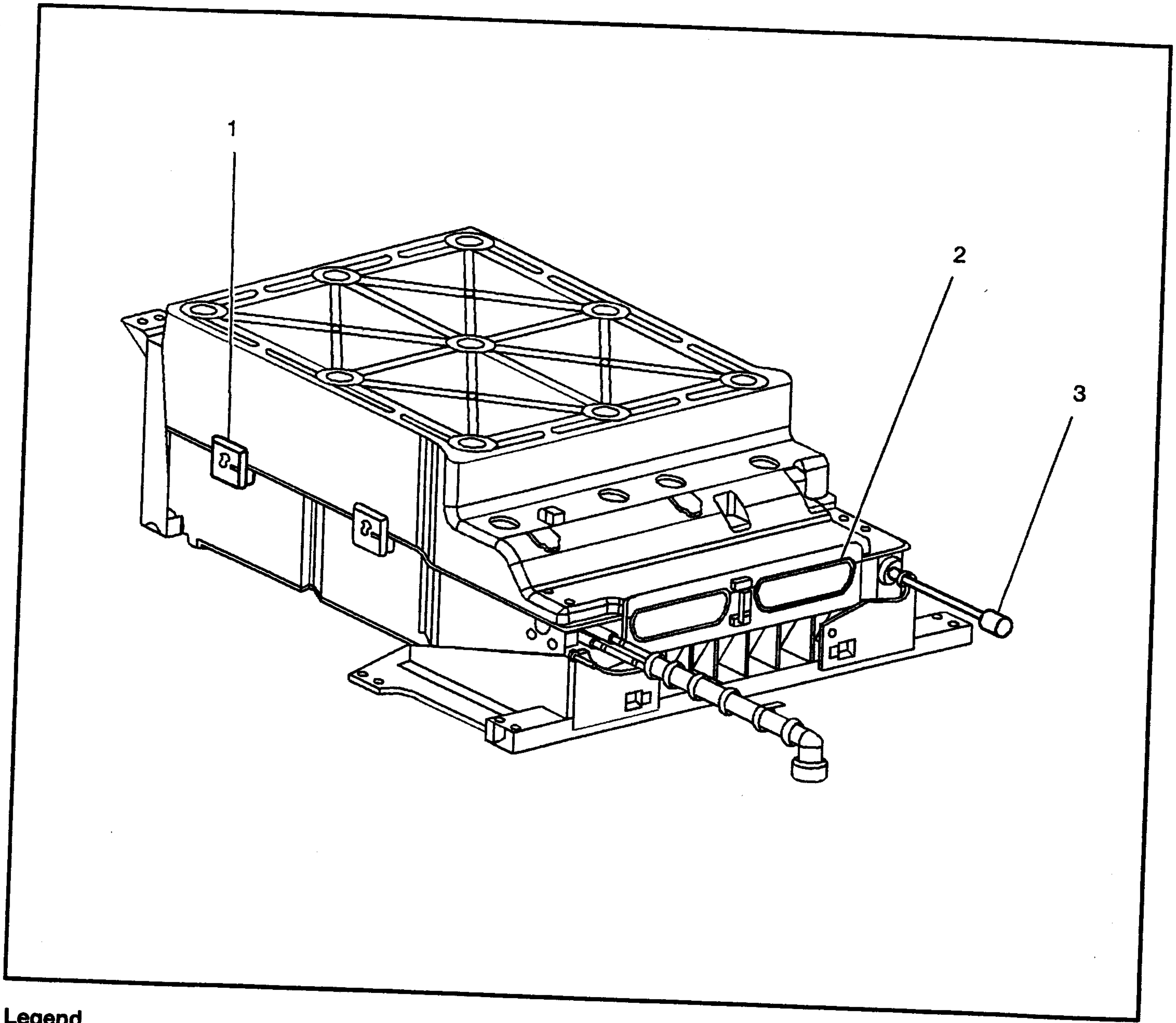
Component Locations



Legend

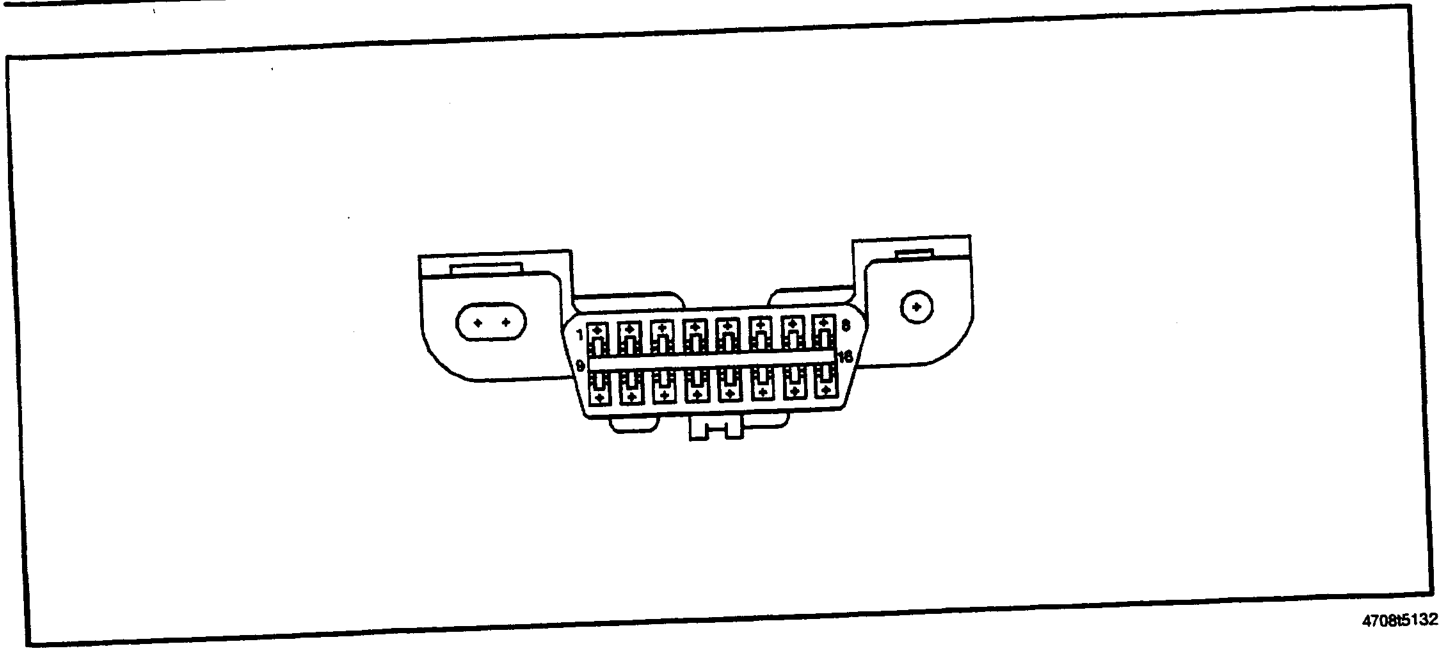
1. Battery Pack
2. Accessory Power Control Module
3. Drive Motor
4. Charge Receptacle
5. Power Steering Control Module
6. Power Inverter Module

Component Locations



167258

Legend
1. Battery Pack Latch
2. Air Duct
3. 20-Way in-line Connector

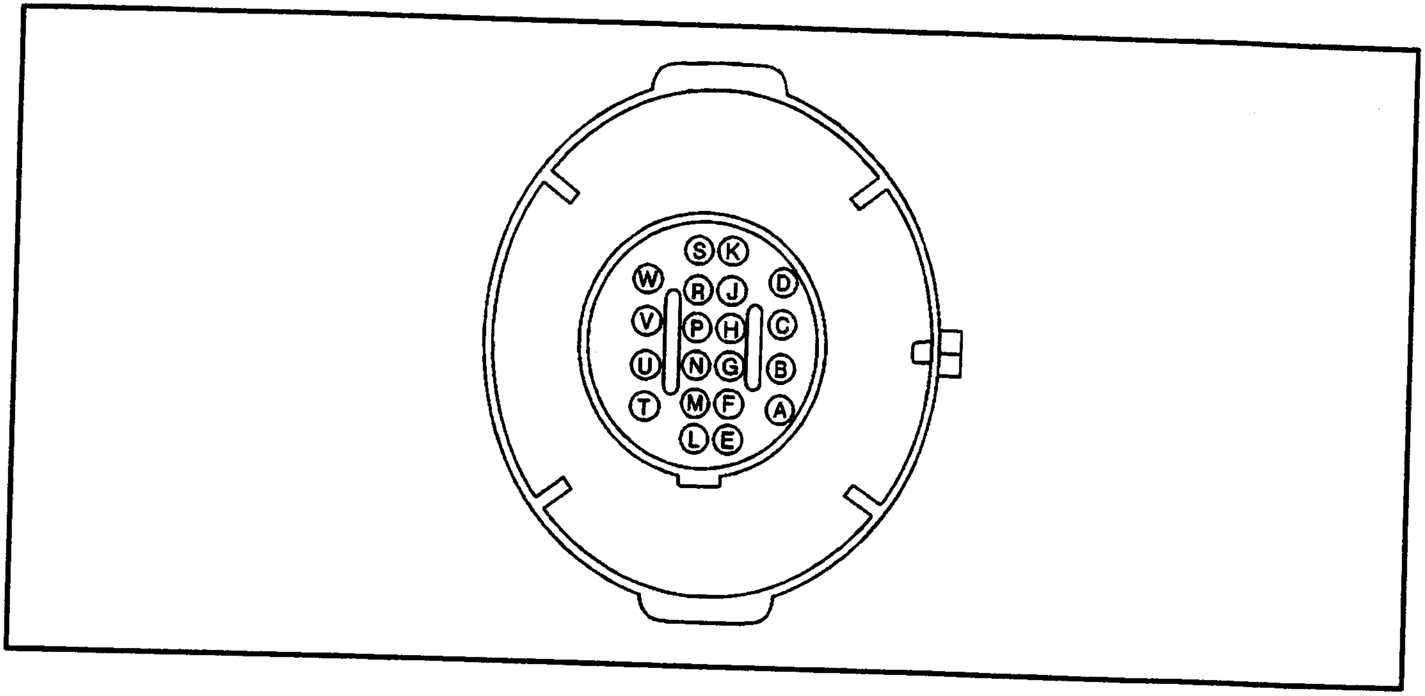


4708t5132

Data Link GRAY Connector Terminal End View

Pin	Function	CKT No.	Color	Refer To
1	Not Used	—	—	—
2	Serial Data Signal-Class B-10400 Baud-Primary	1132	PPL	Electrical Diagnosis
3	Not Used	—	—	—
4	Ground	1850	BLK	Electrical Diagnosis
5	Ground-Clean	451	BLK/WHT	Electrical Diagnosis
6	Not Used	—	—	—
7	Not Used	—	—	—
8	Not Used	—	—	—
9	Serial Data Signal-UART-8192 Baud-Primary	800	TAN	Electrical Diagnosis
10	Not Used	—	—	—
11	Not Used	—	—	—
12	Not Used	—	—	—
13	Not Used	—	—	—
14	Not Used	—	—	—
15	Not Used	—	—	—
16	Fuse Output-Battery	640	ORN	Electrical Diagnosis

(*) For more information refer to *Typical Scan Data Values* within this section.

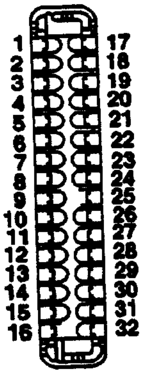


5308v7446

Battery Pack 20-Way In-line GRAY Connector Terminal End View

Pin	Function	CKT No.	Color	Refer To
A	Serial Data Signal-UART-8192 Baud-Primary	800	TAN	Electrical Diagnosis
B	Serial Data Signal-UART-8192 Baud-Primary	800	TAN	Electrical Diagnosis
C	Serial Data Signal-Class B-10400 Baud-Primary	1807	PPL	Electrical Diagnosis
D	Transmission Range Indicator Switch Park Output	275	LT GRN	Electrical Diagnosis
E	Battery Feed	940	ORN	Electrical Diagnosis
F	Ground-Clean	451	BLK/WHT	Electrical Diagnosis
G	Battery Air Flow Sensor Signal	492	YEL	Electrical Diagnosis
H	Battery Air Flow Sensor Return	645	RED/BLK	Electrical Diagnosis
J	Not Used	—	—	—
K	Not Used	—	—	—
L	Charge Receptacle Temperature 5 Volt Reference	5646	WHT	Electrical Diagnosis
M	Charge Receptacle Temperature Return	660	DK BLU	Electrical Diagnosis
N	Not used	—	—	—
P	Not used	—	—	—
R	Fuse Output-Ignition 1 Type III Fuse	1020	PNK	Electrical Diagnosis
S	Vehicle Wake Up	2027	WHT	Electrical Diagnosis
T	High Voltage Disconnect In	951	RED/WHT	Electrical Diagnosis
U	High Voltage Disconnect Out	960	RED	Electrical Diagnosis
V	High Voltage Disconnect	931	BLK	Electrical Diagnosis
W	Power Use Signal	915	YEL/BLK	Electrical Diagnosis

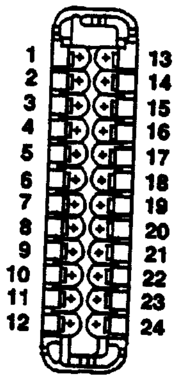
(*) For more information refer to *Typical Scan Data Values* within this section.



Power Inverter Module 32-way CLEAR Connector Terminal End View C1

Pin	Function	CKT No.	Color	Refer To
C1-1	Ground-DMCM	451	BLK/WHT	Electrical Diagnosis
C1-2	Not Used	—	—	—
C1-3	Not Used	—	—	—
C1-4	Vehicle Speed Signal-4000 Pulses Per Mile	817	DK GRN/WHT	Electrical Diagnosis
C1-5	Service Soon Tell-Tale	1855	TAN	Electrical Diagnosis
C1-6	Not Used	—	—	—
C1-7	Stoplamp Switch Signal	1054	ORN	Electrical Diagnosis
C1-8	Charge Tell-Tale Input	2023	DK GRN	Electrical Diagnosis
C1-9	Cruise Control Set/Coast Switch Signal	84	DK BLU	Electrical Diagnosis
C1-10	Cruise Control On Switch Output	397	GRY	Electrical Diagnosis
C1-11	Not Used	—	—	—
C1-12	APP3 Signal	968	LT GRN	Electrical Diagnosis
C1-13	APP2 Signal	965	PNK	Electrical Diagnosis
C1-14	APP1 Signal	962	TAN	Electrical Diagnosis
C1-15	APP3 5 Volt Reference	969	DK GRN	Electrical Diagnosis
C1-16	APP2 5 Volt Reference	966	PPL	Electrical Diagnosis
C1-17	Ground-PSCM	451	BLK/WHT	Electrical Diagnosis
C1-18	Not Used	—	—	—
C1-19	Fuse Output-Ignition 1-Type III Fuse	1020	PNK	Electrical Diagnosis
C1-20	Fuse Output-Battery-Type III Fuse	1040	ORN	Electrical Diagnosis
C1-21	Not Used	—	—	—
C1-22	Serial Data Signal-Uart-8192 Baud-Primary	800	TAN	Electrical Diagnosis
C1-23	Serial Data Signal-Uart-8192 Baud-Primary	800	TAN	Electrical Diagnosis
C1-24	Brake Pedal Switch Output	420	PPL	Electrical Diagnosis
C1-25	Cruise Control Resume/Accel Switch Signal	87	GRY	Electrical Diagnosis
C1-26	Run 2 Relay	241	BRN	Electrical Diagnosis
C1-27	Not Used	—	—	—
C1-28	APP3 Sensor Ground	967	RED	Electrical Diagnosis
C1-29	APP2 Sensor Ground	964	BLK	Electrical Diagnosis
C1-30	APP1 Sensor Ground	963	WHT	Electrical Diagnosis
C1-31	APP1 5 Volt Reference	961	YEL	Electrical Diagnosis
C1-32	Not Used	—	—	—

(*) For more information refer to *Typical Scan Data Values* within this section.

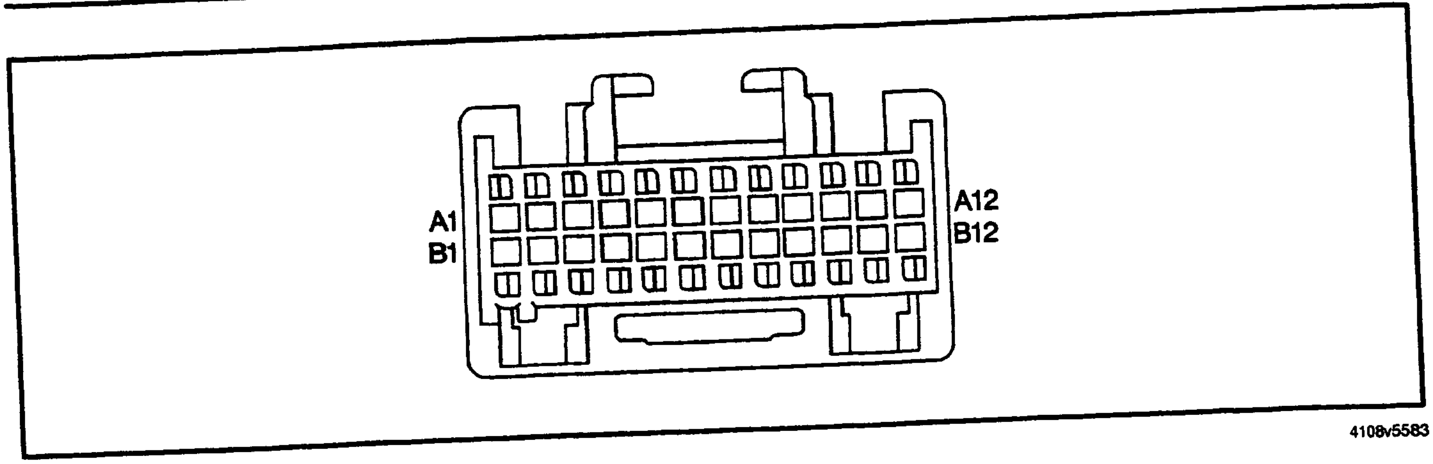


qt0978a202

Power Inverter Module 24-way CLEAR Connector Terminal End View C2

Pin	Function	CKT No.	Color	Refer To
C2-1	Not Used	—	—	—
C2-2	Not Used	—	—	—
C2-3	Not Used	—	—	—
C2-4	Motor Winding Temperature Sensor Signal Return	1798	PNK	Electrical Diagnosis
C2-5	Motor Winding Temperature Sensor Signal	37	DRK GRN	Electrical Diagnosis
C2-6	Transmission Range Indicator Switch Return	470	BLK	Electrical Diagnosis
C2-7	Transmission Range Indicator Switch Parity Bit Input	776	WHT	Electrical Diagnosis
C2-8	Transmission Range Indicator Switch Bit "C" Output	773	GRY	Electrical Diagnosis
C2-9	Transmission Range Indicator Switch Bit "B" Output	772	YEL	Electrical Diagnosis
C2-10	Transmission Range Indicator Switch Bit "A" Output	771	BLK/WHT	Electrical Diagnosis
C2-11	Not Used	—	—	—
C2-12	Not Used	—	—	—
C2-13	Drive Motor Speed and Direction Sensor Signal Power-12 Volt Reference	1673	RED	Electrical Diagnosis
C2-14	Drive Motor Speed and Direction Sensor Signal "A"	1557	DK BLU/WHT	Electrical Diagnosis
C2-15	Drive Motor Speed and Direction Sensor Signal "B"	1558	YEL/BLK	Electrical Diagnosis
C2-16	Drive Motor Speed and Direction Sensor Signal Ground - Return	552	BLK	Electrical Diagnosis
C2-17	Shield Drain Wire	514	BARE	Electrical Diagnosis
C2-18	Not Used	—	—	—
C2-19	Not Used	—	—	—
C2-20	Not Used	—	—	—
C2-21	Not Used	—	—	—
C2-22	Not Used	—	—	—
C2-23	Not Used	—	—	—
C2-24	Not Used	—	—	—

(*) For more information refer to *Typical Scan Data Values* within this section.



Body Control Interface Module 32-way BLUE Connector Terminal End View

Pin	Function	CKT No.	Color	Refer To
C1	Fuse Output, Unlock,Run, Crank, - Type III Fuse	1020	PNK	Electrical Diagnosis
C2	Wait Tell Tale	2029	WHT/BLK	Electrical Diagnosis
C3	Run 2 Relay	541	BRN	Electrical Diagnosis
C4	Stoplamp Switch Input	17	WHT	Electrical Diagnosis
C5	State Of Charge Gauge Signal	915	YEL	Electrical Diagnosis
C6	State Of Charge Gauge Output	922	PPL	Electrical Diagnosis
C7	Fuel Fired Heater Relay Request	903	WHT	Electrical Diagnosis
C8	Not used	—	—	—
C9	Low Heater Fuel Tell Tale Input	30	PPL	Electrical Diagnosis
C10	Fuse Output,Unlock, Run, Crank-Type III Fuse	1020	PNK	Electrical Diagnosis
C11	Vehicle Wake Up	2027	WHT	Electrical Diagnosis
C12	Fuel Fired Heater Relay	913	TAN	Electrical Diagnosis
C13	Not Used	—	—	—
C14	Low Heater Fuel Tell Tale	172	YEL	Electrical Diagnosis
C15	Fuse Output- Battery-Type III Fuse	1740	ORN	Electrical Diagnosis
C16	Accessory Power Module Output Command	5620	ORN	Electrical Diagnosis
D1	Run 2 Relay Request	819	TAN	Electrical Diagnosis
D2	Stoplamp Switch Signal	1054	ORN	Electrical Diagnosis
D3	Battery Air Flow Sensor Signal	492	YEL	Electrical Diagnosis
D4	Battery Air Flow Sensor Return	645	RED/BLK	Electrical Diagnosis
D5	Ground	451	BLK/WHT	Electrical Diagnosis
D6	Secondary Battery Valve Request	1395	LT GRN	Electrical Diagnosis
D7	RT. Rear Wheel Speed High	882	BRN	Electrical Diagnosis
D8	LT. Rear Wheel Speed Low	885	RED	Electrical Diagnosis
D9	RT. Rear Wheel Speed Low	883	WHT	Electrical Diagnosis
D10	LT. Rear Wheel Speed High	884	BLK	Electrical Diagnosis
D11	Battery Fan	5650	PPL	Electrical Diagnosis
D12	Battery Fan Request	268	YEL	Electrical Diagnosis
D13	Secondary Battery Valve	1397	PPL	Electrical Diagnosis
D14	Battery Pack Valve Primary	2901	BLK	Electrical Diagnosis
D15	Primary Battery Valve Relay Control	901	DK BLU	Electrical Diagnosis
D16	Rear Wheel Speed Signal	1827	YEL/BLK	Electrical Diagnosis

(*) For more information refer to *Typical Scan Data Values* within this section.

High Voltage Safety

Caution: DC and AC high voltage. To help avoid injury, always follow the service manual procedures and manually disconnect the high voltage system before working on or around it.

High Voltage Power System Caution

Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled.

The S-10 Electric has both high voltage DC and AC systems, as well as a 12-volt system. DC and AC high voltage are both very dangerous and can cause severe burns and shock. You first need training about how to repair the S-10 Electric and then must follow the proper repair procedures to minimize the risk.

Currents as low as .05 ma AC or 2 ma DC can cause injuries under some conditions. The potential for injury depends on the current path through the body, the amount of current, and how long the current flows through the body. Other factors that influence the effect of current are the body's impedance, the frequency of the current, the moisture level of the skin, the size of the contact area, the pressure exerted, temperature, and the physiological characteristics of the individual.

AC and DC high voltage affect the body differently. The varying current with AC high voltage is more traumatic to the body and can also prevent letting go of the electrodes.

The high voltage system is independent and isolated from the 12-volt system. when a fault is detected, the high voltage system is automatically disconnected. The is also a manual high voltage disconnect that must be used before service work is performed on or around the high voltage system. Refer to *High voltage disable procedure.*

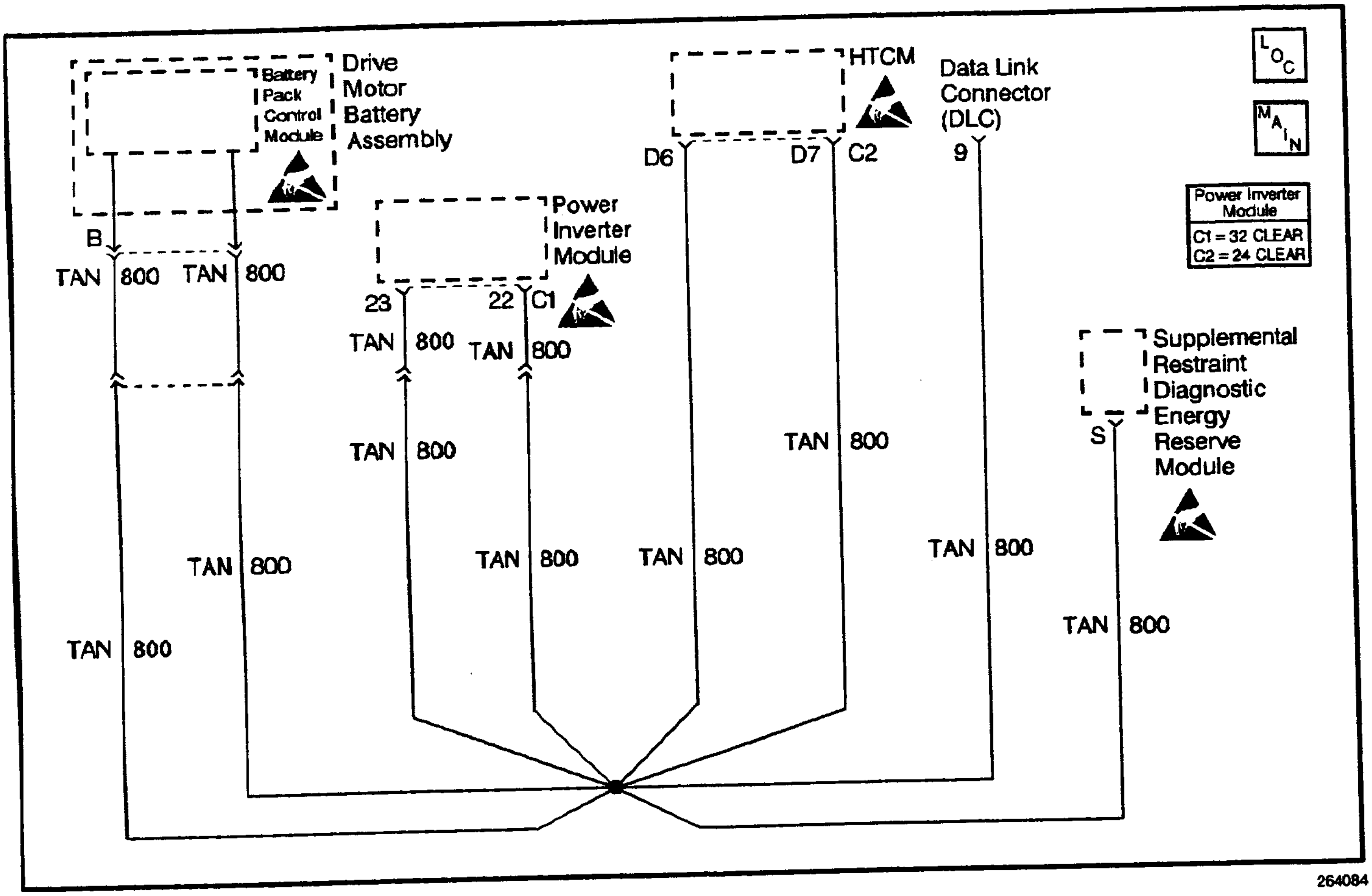
To help avoid injury:

- Do not work on the S-10 Electric without training. Even the greatest gasoline engine technician needs training for this vehicle.
- Follow the service manual procedures and cautions.
- ALWAYS assume that high voltage is present.
- To prevent current from having a path through your body, use one hand to do an operation on the high voltage system.
- Use electrical tape to cover all metal parts of your tools to reduce the chance that the tools will complete a current path.

Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled

Caution: The battery pack has at least 25 times the energy of one regular automotive battery. Extra precautions should be taken when the battery pack is removed from the truck because the automatic disconnect cannot protect you from a disconnected battery pack. Follow the service manual procedures and cautions.

OBD System Check


Battery Pack Control Module
Drive Motor Battery Assembly
HTCM
Data Link Connector (DLC)
Power Inverter Module
Supplemental Restraint Diagnostic Energy Reserve Module
B
D6
D7
C2
9
23
22
C1
S
TAN 800
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
264084

System Description

The on-board diagnostic system check is an organized approach in order to identify a problem created by a control module system malfunction. The on-board diagnostic system check must be the starting point for any driveability or cruise control complaint diagnosis. The on-board diagnostic system check will direct you to the next logical step in diagnosing the complaint. Understanding the chart and using it correctly will reduce diagnostic time and prevent unnecessary replacement of good parts.

Diagnostic Aids

Check for the following conditions:

- Check for loose or damaged connectors at the controller, instrument cluster, and the Body Control Interface Module.

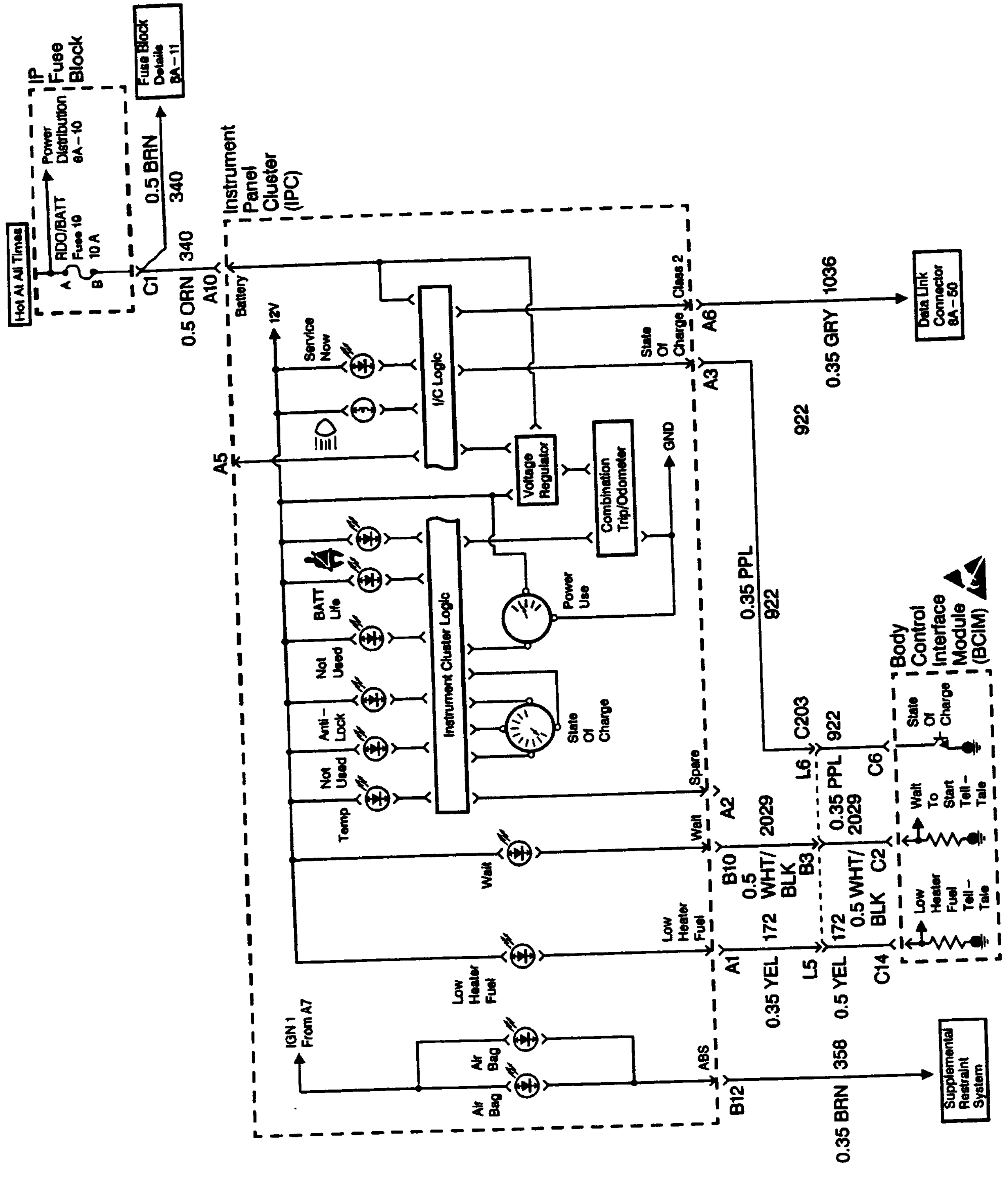
Test Description

1. This step checks lamp function.
4. This step checks serial data communications.
6. This step checks for diagnostic trouble codes.

OBD System Check

Step	Action	Value(s)	Yes	No
1	1. Turn the key to the RUN position. 2. Observe the SERVICE NOW indicator lamp. Is the SERVICE NOW indicator lamp ON during bulb check?	—	Go to Step 2	Go to *No SERVICE NOW Indicator Lamp* table
2	Observe the SERVICE SOON indicator lamp. Was the SERVICE SOON indicator lamp ON during bulb check?	—	Go to Step 3	Go to *No SERVICE SOON Indicator Lamp* table
3	Observe the BATT LIFE indicator lamp. Was the BATT LIFE indicator lamp ON during bulb check?	—	Go to Step 4	Go to *No BATT LIFE Indicator Lamp* table
4	Connect the scan tool. Does the scan tool display serial data from the Drive Motor Control Module, Battery Pack Control Module, and the HTCM?	—	Go to Step 5	Go to *No Serial Data* table
5	Does the scan tool display Class 2 data from the Instrument Panel Cluster?	—	Go to Step 6	Refer to section 8C1
6	Check for any stored DTCs. Are there any DTCs stored in memory?	—	Go to the appropriate DTC table	Go to Step 7
7	Is either the SERVICE SOON, SERVICE NOW, or BATT LIFE lamp ON continuously with no DTCs?	—	Go to *Indicator Lamp Always ON* table	Go to Step 8
8	Compare vehicle scan data with typical scan data values. Are vehicle scan data values within typical ranges?	—	Go to Step 9	Go to the diagnostic check for that component
9	For propulsion driveability symptoms refer to a specific driveability symptom diagnostic table.	—	—	—

Indicator Lamp always ON


Hot At All Times
IP Fuse Block
RDO/BATT Fuse 19 10 A
A
B
Power Distribution 8A-10
Fuse Block Details 8A-11
C1
340
0.5 BRN
340
0.5 ORN
A10
Instrument Panel Cluster (IPC)
Battery
12V
Service Now
I/C Logic
A5
Voltage Regulator
Combination Trip/Odometer
GND
Power Use
BATT Life
Not Used
Anti-Lock
Not Used
Temp
Instrument Cluster Logic
State Of Charge
Class 2
A6
1036
0.35 GRY
Data Link Connector 8A-50
State Of Charge
A3
922
0.35 PPL
922
C203
L6
922
0.35 PPL
C6
Spare
A2
Walt
Walt
B10
2029
0.5 WHT/BLK
B3
0.35 PPL 2029
0.5 WHT/BLK
C2
Low Heater Fuel
A1
172
0.35 YEL
L5
172
0.5 YEL
C14
Body Control Interface Module (BCIM)
State Of Charge
Wait To Start Tell-Tale
Low Heater Fuel Tell-Tale
Low Heater Fuel
IGN 1 From A7
Air Bag
Air Bag
ABS
B12
358
0.35 BRN
Supplemental Restraint System

5308w2491

Circuit Description

There should always be a steady SERVICE SOON, SERVICE NOW and BATT LIFE lamp for 3 to 5 seconds when the ignition is ON during a bulb check. Battery voltage is supplied to the lamp(s) through the instrument cluster. The Power Inverter Module supplies a ground signal to the Instrument Panel Cluster to illuminate the SERVICE SOON lamp. The SERVICE NOW and BATT LIFE lamps are illuminated by the Instrument Panel Cluster which is a Class 2 controlled device.

Diagnostic Aids

Check for the following conditions:

- Check for loose or damaged connectors at the Power Inverter Module, Instrument Panel Cluster, and the Body Control Interface Module.
- Check for short to ground before the control module that controls the lamp in question.

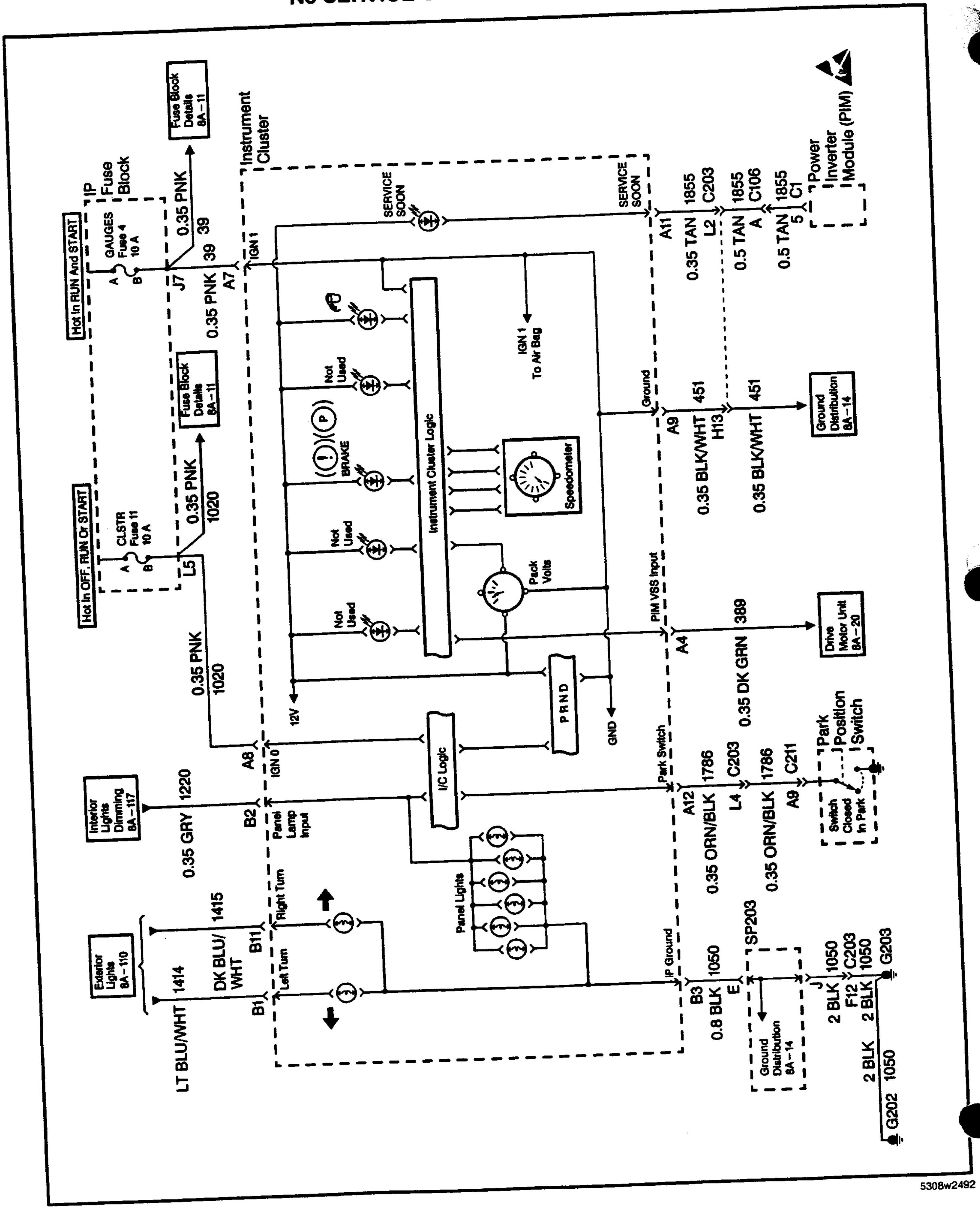
Test Description

2. Check to see if the fault is present.
3. Check to see if the fault is present.
4. Checks for a short to ground before the Power Inverter Module 32-way.
5. Checks for a short to ground between the Power Inverter Module and the Instrument Panel Cluster.

Indicator Lamp Always ON

Step	Action	Value(s)	Yes	No
1	Were you sent here from the On-Board Diagnostic (OBD) System Check?	—	Go to Step 2	Go to *OBD System Check*
2	Is the SERVICE SOON lamp always ON?	—	Go to Step 4	Go to Step 3
3	Is the BATT LIFE or SERVICE NOW Indicator Lamp always ON?	—	Refer to section 8C1	Go to *OBD System Check*
4	1. Turn OFF the ignition switch. 2. Disconnect the Power Inverter Module 32-way connector. 3. Turn ON the ignition switch. Does the SERVICE SOON indicator lamp go OFF?	—	Go to Step 8	Go to Step 5
5	Check for short to ground in control circuit between the Power Inverter Module and the Instrment Panel Cluster. Was a problem Found?	—	Go to Step7	Go to Step 6
6	Replace the I/P cluster. Refer to section 8C1 Is the repair complete?	—	Go to *OBD System Check*	—
7	Repair the wiring harness as required. Refer to *Wiring Repairs* in *Wiring Systems.* Is the repair complete?	—	Go to *OBD System Check*	—
8	Replace the Drive Motor Control Module. Refer To *Power Inverter Module Assembly Removal and Installation.* Is the repair complete?	—	Go to *OBD System Check*	—

No SERVICE SOON Indicator Lamp


Hot In RUN And START
IP Fuse Block
GAUGES Fuse 4 10 A
A
B
J7
39
0.35 PNK
Fuse Block Details 8A-11
Hot In OFF, RUN Or START
CLSTR Fuse 11 10 A
L5
1020
Instrument Cluster
A7
IGN1
SERVICE SOON
A11
1855
0.35 TAN
L2
C203
0.5 TAN
C106
C1
5
Power Inverter Module (PIM)
IGN 1 To Air Bag
Not Used
BRAKE
P
Instrument Cluster Logic
Speedometer
Pack Volts
Ground
A9
451
0.35 BLK/WHT
H13
Ground Distribution 8A-14
PIM VSS Input
A4
389
0.35 DK GRN
Drive Motor Unit 8A-20
12V
PRND
GND
A8
IGN 0
I/C Logic
Park Switch
A12
1786
0.35 ORN/BLK
L4
C211
Park Position Switch
Switch Closed In Park
Interior Lights Dimming 8A-117
1220
0.35 GRY
B2
Panel Lamp Input
Panel Lights
Right Turn
Left Turn
Exterior Lights 8A-110
1415
1414
DK BLU/WHT
LT BLU/WHT
B11
B1
IP Ground
B3
1050
E
0.8 BLK
SP203
J
2 BLK
F12
G203
G202

5308w2492

Circuit Description

There should always be a steady SERVICE SOON lamp for 3 to 5 seconds when the ignition is on during a bulb check. Battery voltage is supplied to the lamp through the instrument cluster. The Drive Motor Control Module is located inside the Power Inverter Module and supplies a ground signal through circuit 1855 to the Instrument Cluster.

Diagnostic Aids

Check for the following conditions:

- Check for loose or damaged connectors at the C106, C203 and the Drive Motor Control Module.
- Run 1 voltage is supplied to the instrument cluster through the radio/batt. fuse 19.

Test Description

2. Forces the service soon lamp on from the Power Inverter Module.
4. Forces the service soon lamp on from the C106 connector.
6. Forces the service soon lamp on from the C203 connector.

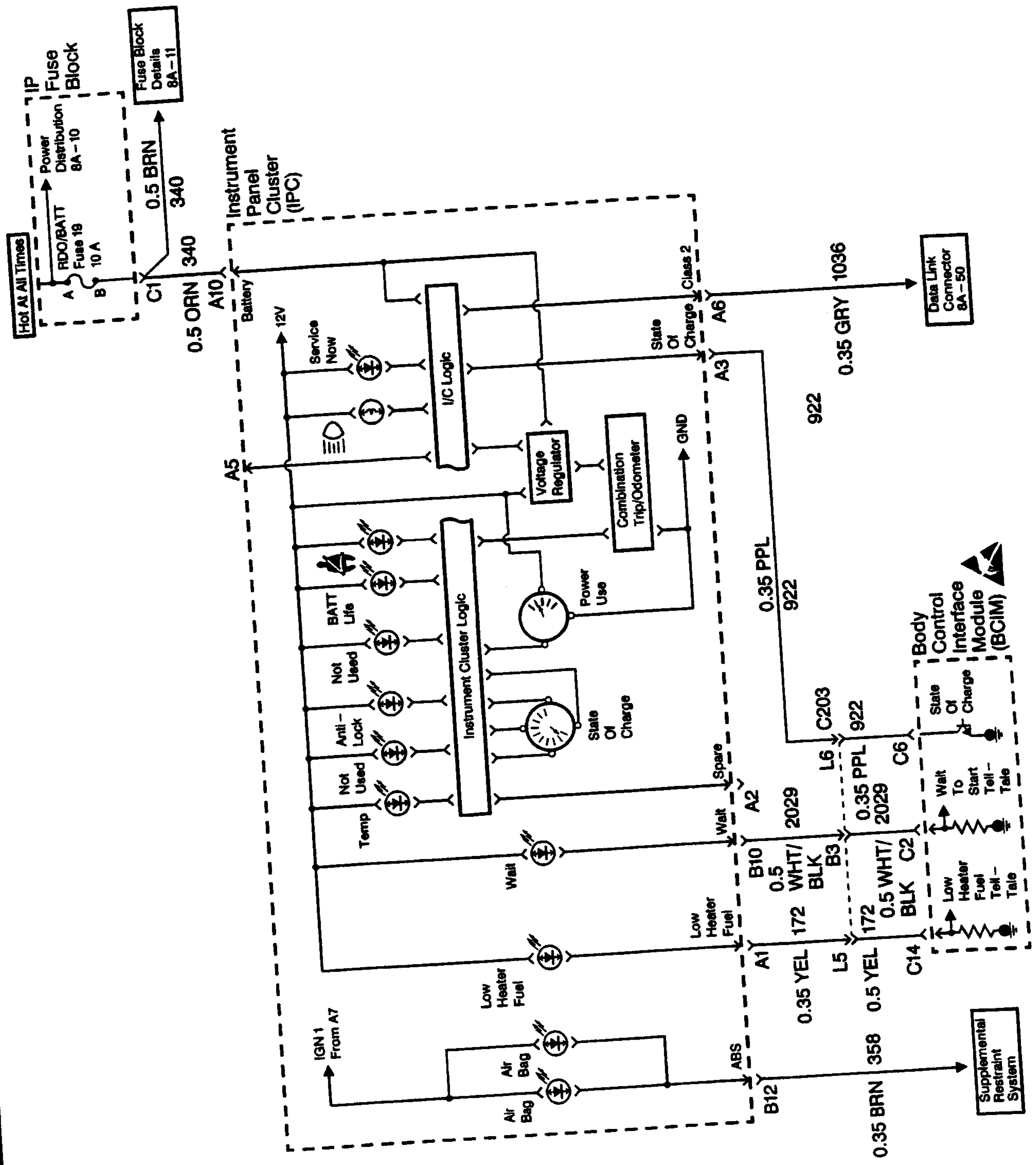
No SERVICE SOON Indicator Lamp

Step	Action	Value(s)	Yes	No
1	Were you sent here from the On-Board Diagnostic (OBD) System Check?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn OFF the ignition switch. 2. Disconnect the Power Inverter Module 32-way connector. 3. Turn ON the ignition switch. 4. Using a fused jumper wire ground circuit 1855 on the 32-way connector. Does the SERVICE SOON indicator lamp turn ON?	—	Go to Step 3	Go to Step 4
3	Check for a poor connection at the Power Inverter Module. Was a poor connection found?	—	Go to Step 10	Go to Step 12
4	1. Disconnect the C106 connector. 2. Using a fused jumper wire apply ground to circuit 1855 to the IP cluster. Does the SERVICE SOON indicator lamp turn ON?	—	Go to Step 5	Go to Step 6
5	Check for continuity on circuit 1855 between the Power Inverter Module and connector C106 Is continuity present?	—	Go to Step 11	Go to Step 10
6	1. Disconnect the C203 connector. 2. Using a fused jumper wire apply ground to circuit 1855 to the IP cluster. Does the SERVICE SOON indicator lamp turn ON?	—	Go to Step 7	Go to Step 8
7	Check for continuity on circuit 1855 between the C106 and connector C203. Is continuity present?	—	Go to Step 11	Go to Step 10
8	Remove the instrument cluster and check for continuity on circuit 1855 between the C203 and the instrument cluster. Is continuity Present	—	Go to Step 9	Go to Step 11
9	Replace the instrument cluster.	—	Go to *OBD System Check*	—

No SERVICE SOON Indicator Lamp (continued)

Step	Action	Value(s)	Yes	No
10	Repair the wiring harness as required. Refer to *Wiring Repairs* in *Wiring Systems.* Is the repair complete?	—	Go to *OBD System Check*	—
11	Repair the wiring connection at the Connector as required. Refer to *Wiring Repairs* in *Wiring Systems.* Is the repair complete?	—	Go to *OBD System Check*	—
12	Replace the Drive Motor Control Module. Refer To *Power Inverter Module Assembly Removal and Installation.* Is the repair complete?	—	Go to *OBD System Check*	—

No SERVICE NOW Indicator Lamp


Hot At All Times
RDO/BATT Fuse 19 10 A
A
B
Power Distribution 8A-10
IP Fuse Block
Fuse Block Details 8A-11
0.5 BRN
340
C1
340
0.5 ORN
A10
Instrument Panel Cluster (IPC)
Battery
12V
Service Now
I/C Logic
Class 2
A6
1036
0.35 GRY
Data Link Connector 8A-50
State Of Charge
A3
922
A5
Voltage Regulator
Combination Trip/Odometer
GND
Power Use
BATT Life
Not Used
Anti-Lock
Not Used
Temp
Instrument Cluster Logic
State Of Charge
0.35 PPL
922
Body Control Interface Module (BCIM)
C203
922
L6
0.35 PPL
C6
Spare
A2
2029
Wait
B10
0.5 WHT/BLK
B3
0.35 WHT/2029
0.5 WHT/BLK
C2
State Of Charge
Wait To Start Tell-Tale
Low Heater Fuel
A1
172
0.35 YEL
L5
172
0.5 YEL
C14
Low Heater Fuel Tell-Tale
Low Heater Fuel
IGN 1 From A7
Air Bag
Air Bag
ABS
B12
358
0.35 BRN
Supplemental Restraint System

5308w249

Circuit Description

There should always be a steady SERVICE SOON, SERVICE NOW and BATT LIFE lamp for 3 to 5 seconds when the ignition is ON during a bulb check. Battery voltage is supplied to the lamp(s) through the instrument cluster. The Power Inverter Module supplies a ground signal to the Instrument Panel Cluster to illuminate the SERVICE SOON lamp. The SERVICE NOW and BATT LIFE lamps are illuminated by the Instrument Panel Cluster which is a Class 2 controlled device.

Diagnostic Aids

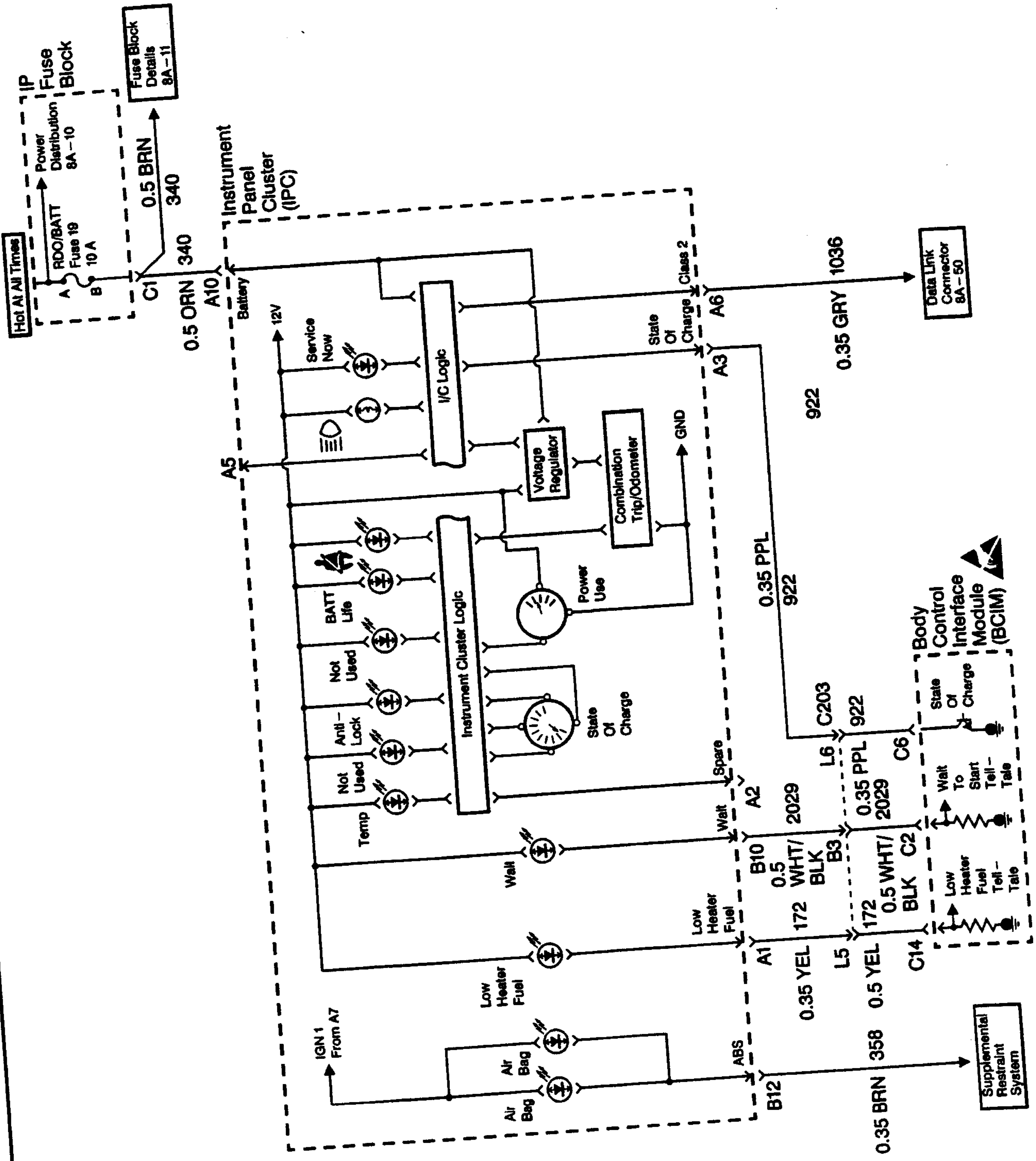
Check for the following conditions:

Using the Special Function feature of the scan tool, command the indicator lamp ON.

No SERVICE NOW Indicator Lamp

Step	Action	Value(s)	Yes	No
1	Were you sent here from the On-Board Diagnostic (OBD) System Check?	—	Refer to section 8C1	Go to *OBD System Check*

No BATT LIFE Indicator Lamp


Hot At All Times
RDO/BATT Fuse 19 10 A
A
B
Power Distribution 8A-10
IP Fuse Block
Fuse Block Details 8A-11
0.5 BRN
340
C1
340
0.5 ORN
A10
Instrument Panel Cluster (IPC)
Battery
12V
Service Now
I/C Logic
Class 2
A6
1036
0.35 GRY
Data Link Connector 8A-50
State Of Charge
A3
922
A5
Voltage Regulator
Combination Trip/Odometer
GND
Power Use
Instrument Cluster Logic
BATT Life
Not Used
Anti-Lock
Not Used
Temp
State Of Charge
0.35 PPL
922
C203
922
L6
0.35 PPL
2029
C6
Body Control Interface Module (BCIM)
State Of Charge
Spare
A2
2029
Wait
B10
0.5 WHT/BLK
B3
0.5 WHT/BLK
C2
Wait To Start Tell-Tale
Low Heater Fuel
A1
172
L5
172
0.35 YEL
0.5 YEL
C14
Low Heater Fuel Tell-Tale
Low Heater Fuel
IGN 1 From A7
Air Bag
Air Bag
ABS
B12
358
0.35 BRN
Supplemental Restraint System

5308w2

Circuit Description

There should always be a steady SERVICE SOON, SERVICE NOW and BATT LIFE lamp for 3 to 5 seconds when the ignition is ON during a bulb check. Battery voltage is supplied to the lamp(s) through the instrument cluster. The Power Inverter Module supplies a ground signal to the Instrument Panel Cluster to illuminate the SERVICE SOON lamp. The SERVICE NOW and BATT LIFE lamps are illuminated by the Instrument Panel Cluster which is a Class 2 controlled device.

Diagnostic Aids

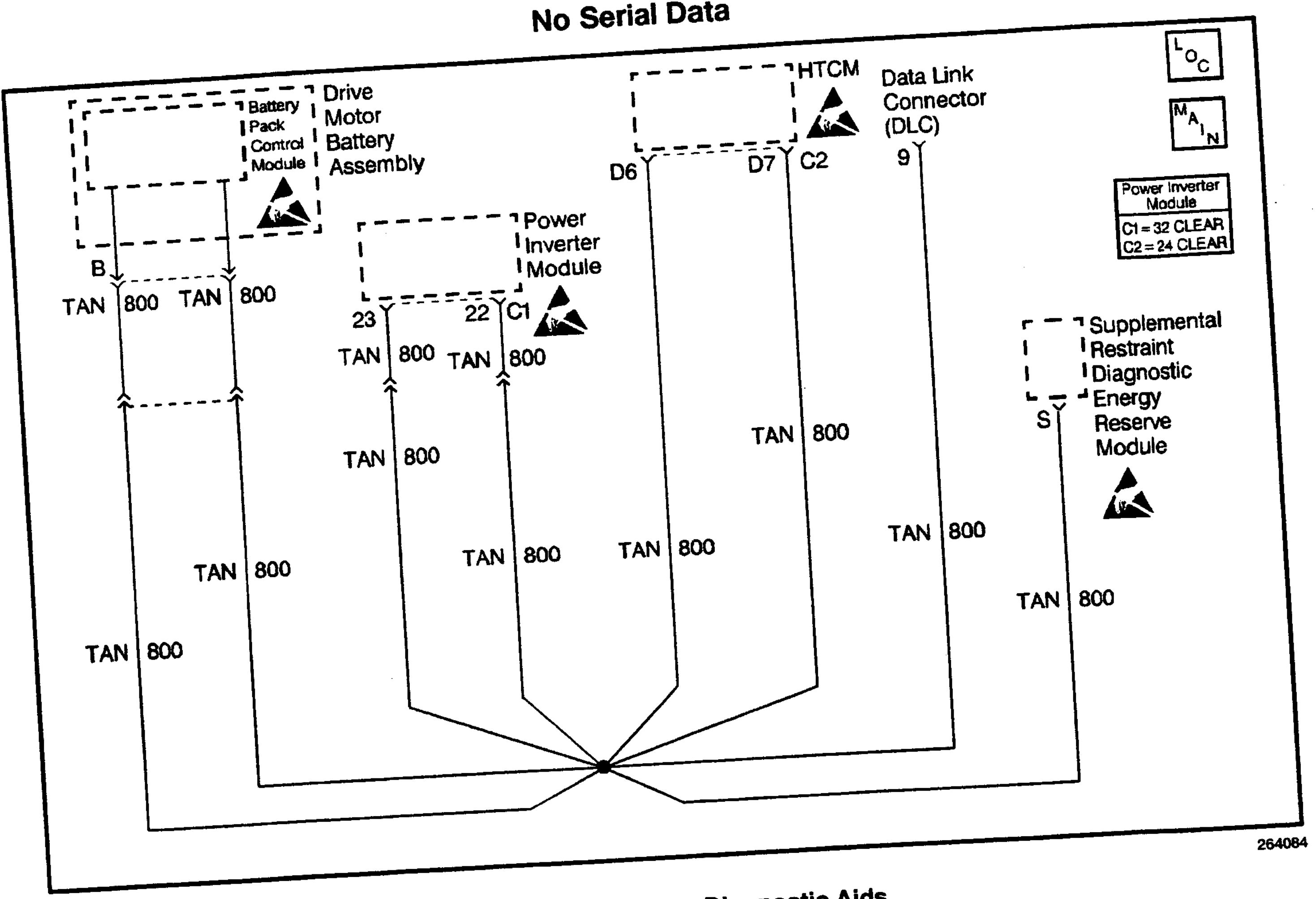
Check for the following conditions:

- Using the Special Function feature of the scan tool, command the indicator lamp ON.

No BATT LIFE Indicator Lamp

Step	Action	Value(s)	Yes	No
1	Were you sent here from the On-Board Diagnostic (OBD) System Check?	—	Refer to section 8C1	Go to *OBD System Check*

No Serial Data


Battery Pack Control Module
Drive Motor Battery Assembly
HTCM
Data Link Connector (DLC)
Power Inverter Module
Supplemental Restraint Diagnostic Energy Reserve Module
B
TAN 800
D6
D7
C2
9
23
22
C1
S
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
264084

Circuit Description

UART is an interfacing device that allows the on board computers to send and receive serial data. Serial data refers to information which is transferred in a linear fashion - over a single line, one bit at a time. The UART system uses a redundant wire system to ensure communications even if one line has an open. There should always be a steady SERVICE SOON lamp for 3 to 5 seconds when the ignition is ON during a bulb check. Battery voltage is supplied to the lamp through the instrument cluster. The Drive Motor Control Module turns the lamp on by applying a ground to the control circuit during a bulb check or when a DTC sets and the DTC meets the requirements for illuminating the lamp. The SERVICE NOW and BATT LIFE lamps are illuminated by the Instrument Panel Cluster which is a Class 2 controlled device.

Diagnostic Aids

Check for the following conditions:

- A grounded serial data line will pull the entire circuit low and not allow any communication.
- The UART system uses a redundant wire system to ensure communications even if one line has an open. If only one control module will not talk on the serial data line check the control module.

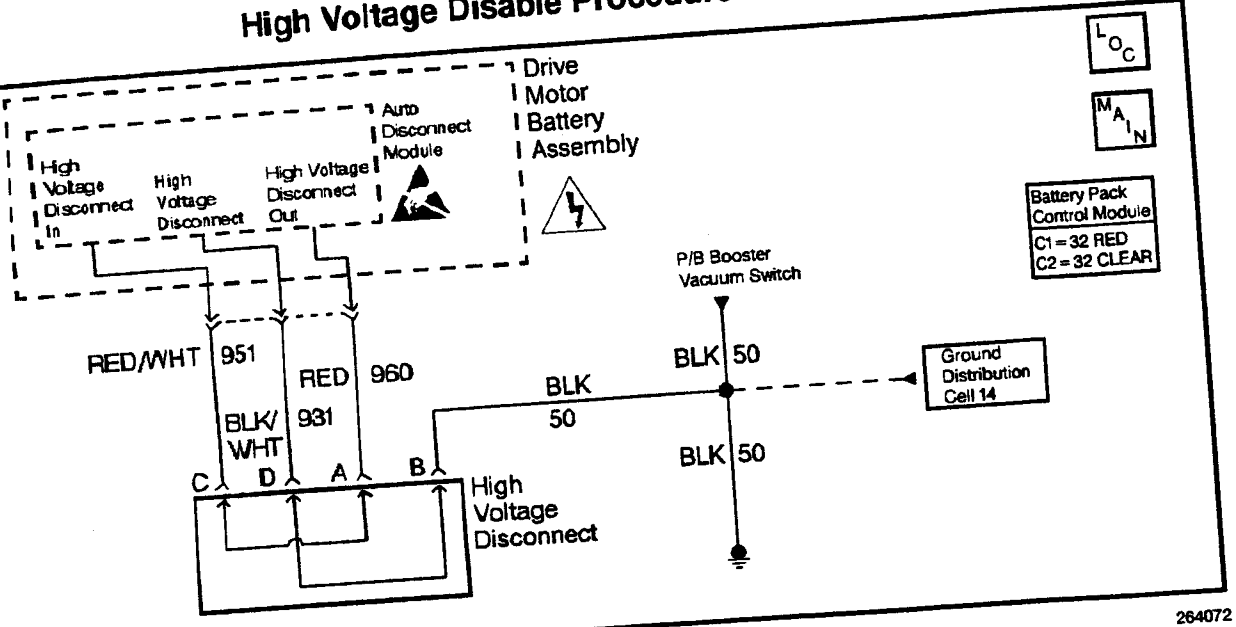
Test Description

2. This step checks for communications with all controllers.
6. This step checks for a problem on the serial data circuit.

No serial Data

Step	Action	Value(s)	Yes	No
1	Were you sent here from the On-Board Diagnostic (OBD) System Check?	—	Go to Step 2	Go to *OBD System Check*
2	Using a scan tool attempt to access serial data from the Drive Motor Control Module, Battery Pack Control Module, and HTCM. Is any serial data present?	—	Go to Step 3	Go to Step 6
3	Can the scan tool communicate with the Battery Pack Control Module?	—	Go to Step 4	Go to Step 7
4	Can the scan tool communicate with the Drive Motor Control Module?	—	Go to Step 5	Go to Step 8
5	Can the scan tool communicate with the HTCM?	—	System OK	Go to Step 9
6	1. Turn OFF the ignition switch. 2. Check for an open in the serial data circuit. 3. Check for a short to ground in the serial data circuit. 4. Check for a short to voltage in the serial data circuit. Is the action complete?	—	Go to Step 10	—
7	Check for an open or poor connection between the Battery Pack Control Module and the splice. Was a problem found?	—	Go to Step 10	Go to Step 11
8	Check for an open or poor connection between the Power Inverter Module and the splice. Was a problem found?	—	Go to Step 10	Go to Step 12
9	Check for an open or poor connection between the HTCM and the splice. Was a problem found?	—	Go to Step 10	Go to Step 13
10	Repair the wiring harness as required. Refer to *Wiring Repairs* in *Wiring Systems.* Is the repair complete?	—	Go to *OBD System Check*	—
11	Replace the Battery Pack Control Module. Refer To *Battery Pack Service Manual.* Is the repair complete?	—	Go to *OBD System Check*	—
12	Replace the Drive Motor Control Module. Refer To *Power Inverter Module Assembly Removal and Installation.* Is the repair complete?	—	Go to *OBD System Check*	—
13	Replace the HTCM. Refer To *HTCM Removal and Installation.* Is the repair complete?	—	Go to *OBD System Check*	—

High Voltage Disable Procedure


Drive Motor Battery Assembly
Auto Disconnect Module
High Voltage Disconnect In
High Voltage Disconnect
High Voltage Disconnect Out
P/B Booster Vacuum Switch
Battery Pack Control Module
C1 = 32 RED
C2 = 32 CLEAR
RED/WHT 951
RED 960
BLK/WHT 931
BLK 50
Ground Distribution Cell 14
C D A B
High Voltage Disconnect
264072

Circuit Description

The high voltage disconnect connector is the end of a four wire extension from the automatic disconnect. By removing the connector the ground path to the high voltage relays are removed. At the same time a internal battery pack ground unbalance is created that requires the automatic disconnect to command the high voltage open. The high voltage disconnect connector should be locked in the glove-box or other secure area during vehicle service.

Diagnostic Aids

Check for the following conditions:

- An audible click should be heard when the high voltage disconnect connector is removed. This click indicates the automatic disconnect high voltage relays have opened.
- If the High Voltage Disconnect is removed with the key ON Battery Pack Control Module DTC 278 and Drive Motor Control Module DTC 070 will be set. After removing the High Voltage Disconnect, Connect a scan tool to the data link connector (DCL) and view the Diagnostic Trouble Codes. Battery Pack Control Module DTC 278 and Drive Motor Control Module DTC 070 should be present, which indicates the Battery Pack Control Module and Auto Disconnect recognized a high voltage disconnect.
- Using a scan tool, the voltage on the Power Inverter Module High Voltage buss can be read through the Drive Motor Control Module data list.

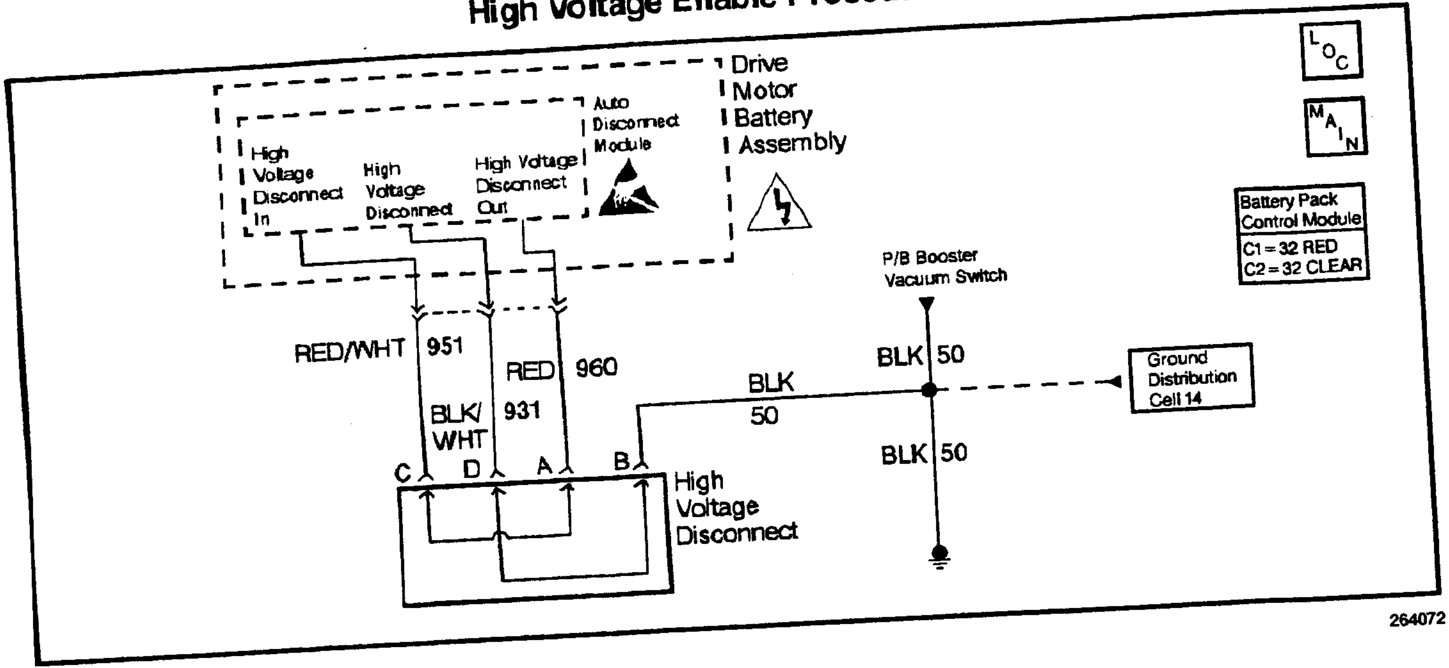
Test Description

1. Checks for other related Diagnostic Trouble Codes.
3. This is the initial step in containing high voltage inside the battery pack.
4. Checks for remaining high voltage through the use of the power steering pump.
5. This is the physical check of the battery connector to assure no high voltage is present.
6. This step checks if the high voltage can be depleted by the power steering pump or if the battery pack high voltage has not been disabled.

High Voltage Disable Procedure

Step	Action	Value(s)	Yes	No
1	**Important:** The OBD System Check must be performed prior to performing the High Voltage Disable Procedure. Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Was a Drive Motor Control Module DTC 105 set.	—	Go to DTC 105 first	Go to Step 3
3	***Notice:*** During charging do not remove the high voltage service disconnect. Vehicle damage will result. ***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled.*** With the key OFF and the charger disconnected remove the manual high voltage service disconnect. Is the action complete?	—	Go to Step 4	—
4	Turn the key ON and check if the power steering pump runs after the specified time. ***Notice:*** The power steering pump requires 20 seconds to initialize after key up. Did the power steering pump run after the specified time?	20 seconds	Go to Step 6	Go to Step 5
5	***Caution: Always treat high voltage cables and connectors as if voltage is present.*** 1. Remove the battery pack high voltage cannon connector from the back of the Inverter Module. 2. Using a DMM probe the two large terminals on the battery pack cable cannon connector. Is the voltage less than the specified value?	5 Volts	Go to Step 9	Go to Step 7
6	Did the power steering pump run longer then the specified value?	1 minute	Go to Step 7	Go to Step 8
7	***Caution: The Battery pack high voltage system did not power down. The high voltage system still contains high voltage.*** Internal Battery Pack service is required. Refer to the *Battery Pack Service Manual.*	—	—	—
8	Replace the Power Inverter Module. Refer to *Power Inverter Module Assembly Removal and Installation.* ***Notice:*** If the control module is faulty, the new control module must be programmed. Refer to *control module programming procedures.* Is the action complete?	—	Go to Step 9	—
9	Proceed with vehicle service.	—	—	—

High Voltage Enable Procedure


Drive Motor Battery Assembly
Auto Disconnect Module
High Voltage Disconnect In
High Voltage Disconnect
High Voltage Disconnect Out
LOC
MAIN
Battery Pack Control Module
C1 = 32 RED
C2 = 32 CLEAR
P/B Booster Vacuum Switch
RED/WHT 951
RED 960
BLK/WHT 931
BLK 50
BLK 50
BLK 50
BLK 50
Ground Distribution Cell 14
C
D
A
B
High Voltage Disconnect
264072

Circuit Description

The high voltage disconnect connector is the end of a four wire extension from the automatic disconnect. By removing the connector the ground path to the high voltage relays are removed. At the same time a internal battery pack ground imbalance is created that requires the automatic disconnect to command the high voltage open. The high voltage disconnect connector should be locked in the glove box or other secure area during vehicle service.

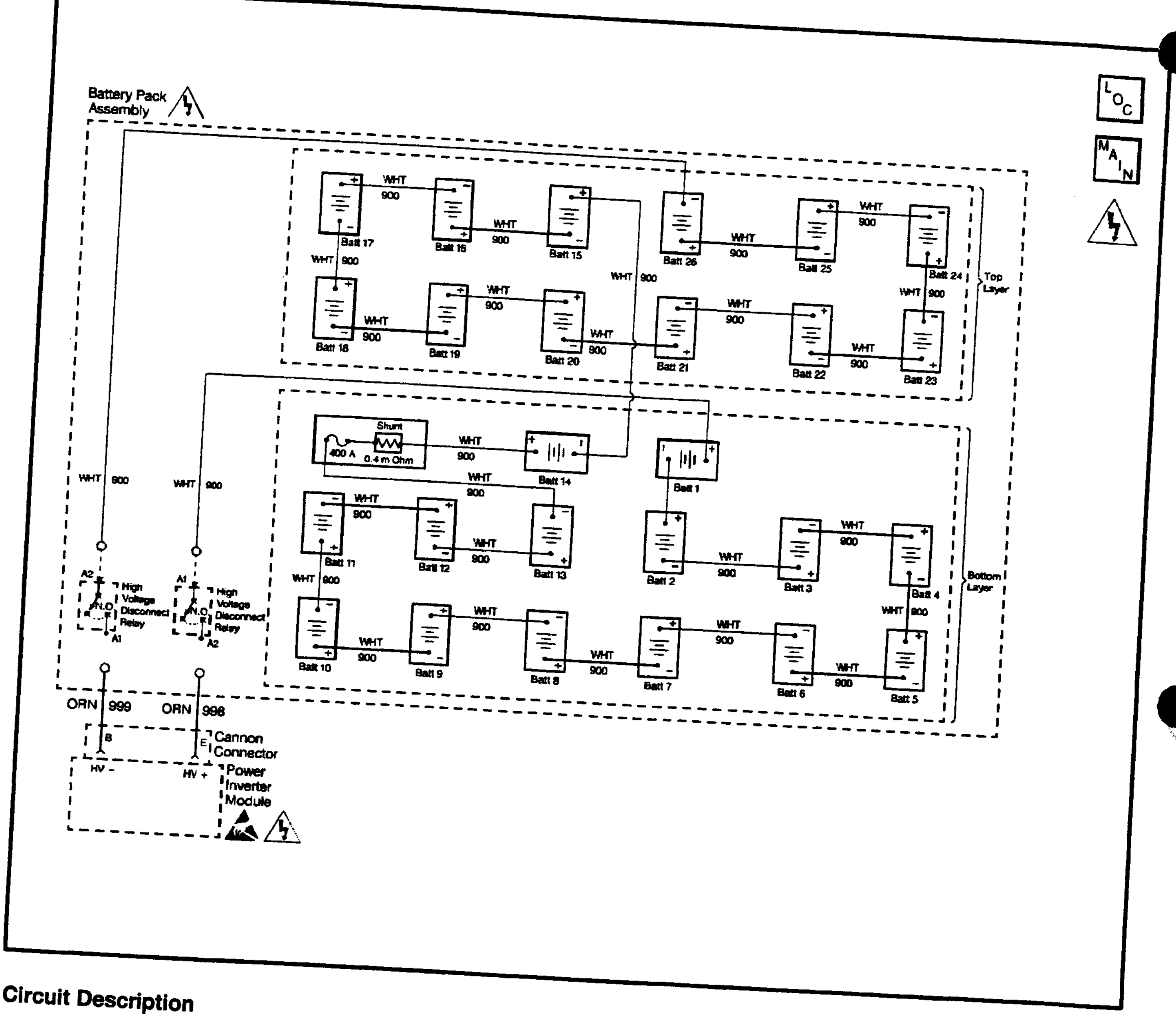
Test Description

1. Checks for other related Diagnostic Trouble Codes.
2. Checks that the high voltage wiring is connected.
3. Supplies the ground paths back to the automatic disconnect and the high voltage relays

High Voltage Enable Procedure

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Ensure that all wiring with orange conduit is connected to proper components. Is the action complete?	—	Go to Step 3	—
3	***Notice:*** Do not enable the high voltage system with the charger connected to the charge receptacle. Vehicle damage will result. With the key OFF and the charger disconnected replace the manual high voltage service disconnect. Is the action complete?	—	Go to Step 4	—
4	Turn the key ON and check each control module for DTC(s). Were any DTC(s) present?	—	Go to other DTC(s)	System OK

Battery Pack Discharge Test


Battery Pack Assembly
L O C
M A I N
Batt 17
Batt 16
Batt 15
Batt 26
Batt 25
Batt 24
Batt 18
Batt 19
Batt 20
Batt 21
Batt 22
Batt 23
Top Layer
WHT 900
Shunt
400 A
0.4 m Ohm
Batt 14
Batt 1
Batt 11
Batt 12
Batt 13
Batt 2
Batt 3
Batt 4
Batt 10
Batt 9
Batt 8
Batt 7
Batt 6
Batt 5
Bottom Layer
A2
A1
N.O
High Voltage Disconnect Relay
ORN 999
ORN 998
B
E
Cannon Connector
HV -
HV +
Power Inverter Module

210024

Circuit Description

Battery Pack capacity is measured in amp hours by the Battery Pack Control Module. In order for the amp hour value to be accurate the pack must be discharged at a constant rate. The Battery Pack discharge test is designed to verify that the battery pack has at least 38.4 amp hours of capacity at a discharge rate of 25 amp hours. This is accomplished by placing a load on the battery pack until 38.4 amp hours has been removed then replacing battery modules that became discharged before the test was complete. A battery that has less then 38.4 amp hours capacity will set one or more DTC(s) during the discharge test and require replacement. This test should only be run if you have been directed to do so from another DTC or symptom table.

Conditions for Running the Test

Caution: To prevent personal injury, do not touch or place any object on the surface of the J 42860 Battery Pack Discharge tool when in use. Surface temperature can exceed 149°C (300°F).

- The battery pack must successfully precharge special tool J 42860 Battery Pack Precharge/Discharge Tester.
- The average battery pack temperature is greater then 20°C (68°F).
- The true SOC is greater then 95%.
- The vehicle must be in park.
- The charge paddle is not inserted into the charge receptacle.

Action Taken When Test is Initiated

- The scan tool will clear DTC(s) on the Battery Pack Control Module.
- The Automatic Disconnect will disregard Battery Pack Control Module requests to open the high voltage relays for low module DTC(s), but will respond to any interlock or isolation faults.
- The scan tool will automatically begin to collect snapshot data after the battery pack has been discharged to 27 amp hours.
- When the battery pack has been discharged to 38.4 amp hours the automatic disconnect will open the high voltage relays and any DTC(s) related to the test will be displayed on the scan tool.

Diagnostic Aids

- The test can be aborted at any time by pressing the "EXIT" key on the scan tool.
- The test will be aborted anytime the Battery Pack Control Module sees battery pack voltage below 200 volts.
- If the automatic disconnect opens the high voltage relays due to any fault excluding Battery Pack Control Module commanded. At this point the discharge test will be aborted.
- If Battery Pack Control Module DTC(s) 302 - 312 are set the test will be considered invalid and the related diagnostic trouble code chart should be referenced.
- If one or more battery modules have a significantly different voltage then the pack average the pack will precharge, then open the high voltage relays after 30 seconds. In this case the test can not be run and battery modules that have set Very Low Voltage \ Circuit No Voltage DTC(s) should be replaced after checking for poor connections.

Caution: Hearing a click from the battery pack is not a substitute for performing the High Voltage Disable Procedure.

- An audible click should be heard when the high voltage disconnect connector is removed. This click indicates the automatic disconnect high voltage relays have opened.
- If the High Voltage Disconnect is removed with the key ON Battery Pack Control Module DTC 278 and Drive Motor Control Module DTC 070 will be set.
- If the Battery Pack will not meet the conditions for running the Pack Discharge Test, it may be necessary to perform other pack service first.
- Be sure to check for loose or damaged battery interconnects and sense leads before replacing and battery modules.
- If battery modules set only circuit no voltage DTC(s) check for loose voltage sense or interconnects leads.

Test Description

1. Checks for other related Diagnostic Trouble Codes.
2. This prepares the vehicle for the test.
3. Connects the load device to the battery pack high voltage system.
5. Forces the automatic disconnect to keep the high voltage relays closed for battery module related DTC(s).

Battery Pack Discharge Test

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic (OBD) System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Charge the vehicle to COMPLETE. Can the vehicle be charged?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Remove the charge paddle from the charge receptacle. 2. Perform the High Voltage Disable Procedure. Refer to *High Voltage Disable Procedure.* 3. Remove the Battery Pack High Voltage supply cannon connector from the back of the Power Inverter Module. 4. Connect the special tool J 42493 Battery Pack to Power Inverter Extension Cable to the Battery Pack High Voltage supply cannon connector. 5. Connect the special tool J 42860 Battery Pack Precharge/Discharge Tester to the J 42493 Battery Pack to Power Inverter Extension Cable. 6. Connect the Discharge Resistor Bank to the J 42860 Battery Pack Precharge/Discharge Tester Control Box. 7. Perform the High Voltage Enable procedure. Refer to *High Voltage Enable Procedure.* Are the actions completed?	—	Go to Step 4	—
4	Insure that all of the Conditions for Running the Test have been met. Refer to the Facing page under *Conditions for Running the Test.* Have all of the test conditions been met?	—	Go to Step 5	Go to Step 7
5	1. Turn the key to the RUN position. 2. Using a scan tool initiate the Battery Pack Discharge Test. 3. Using special tool J 42860 begin discharging the battery pack by turning the switch on the control box to the ON position. 4. Allow the battery pack to discharge to 38.4 amp hours. ***Notice:*** The scan tool will automatically open the high voltage relays and conclude the test when the battery pack has reached 38.4 amp hours. Did the test complete?	—	Go to Step 6	Go to Diagnostic Aids
6	Using a scan tool review the stored DTC(s). Are any Very Low Voltage DTC(s) set?	—	Go to Step 9	Go to Step 8
7	Allow the vehicle to meet the specified test conditions. Is the action complete?	—	Go to Step 4	Go to Diagnostic Aids
8	No battery module replacement is necessary. Refer to other DTC(s). Is the action complete?	—	Go to Step 10	—
9	Were you sent here from the symptoms section?	—	Go to Step 11	Go to Step 10
10	Note but do not replace any batteries that have set DTC(s) and return to the battery module chart. Is the action complete?	—	Go to Step 12	—
11	Replace the battery module(s) that have set DTC(s). Also replace any battery modules that have set Performance or Out of Range DTC(s). Refer to *Battery module removal and installation procedure.* Is the action complete?	—	Go to Step 12	—
12	Clear DTC's. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

Battery Pack Control Module Diagnostic Trouble Codes

DTC	Description	Illuminate MIL
001	Battery 1 Circuit No Voltage	SERVICE SOON
003	Battery 1 Performance	—
004	Battery 1 Out of Range	—
005	Battery 1 Circuit Low Voltage	BATT LIFE
006	Battery 1 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
007	Battery 1 Over voltage	SERVICE NOW
009	Battery 2 Circuit No Voltage	SERVICE SOON
011	Battery 2 Performance	—
012	Battery 2 Out of Range	—
013	Battery 2 Circuit Low Voltage	BATT LIFE
014	Battery 2 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
015	Battery 2 Over voltage	SERVICE NOW
017	Battery 3 Circuit No Voltage	SERVICE SOON
019	Battery 3 Performance	—
020	Battery 3 Out of Range	—
021	Battery 3 Circuit Low Voltage	BATT LIFE
022	Battery 3 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
023	Battery 3 Over voltage	SERVICE NOW
025	Battery 4 Circuit No Voltage	SERVICE SOON
027	Battery 4 Performance	—
028	Battery 4 Out of Range	—
029	Battery 4 Circuit Low Voltage	BATT LIFE
030	Battery 4 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
031	Battery 4 Over voltage	SERVICE NOW
033	Battery 5 Circuit No Voltage	SERVICE SOON
035	Battery 5 Performance	—
036	Battery 5 Out of Range	—
037	Battery 5 Circuit Low Voltage	BATT LIFE
038	Battery 5 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
039	Battery 5 Over voltage	SERVICE NOW
041	Battery 6 Circuit No Voltage	SERVICE SOON
043	Battery 6 Performance	—
044	Battery 6 Out of Range	—
045	Battery 6 Circuit Low Voltage	BATT LIFE
046	Battery 6 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
047	Battery 6 Over voltage	SERVICE NOW
049	Battery 7 Circuit No Voltage	SERVICE SOON
051	Battery 7 Performance	—
052	Battery 7 Out of Range	—
053	Battery 7 Circuit Low Voltage	BATT LIFE
054	Battery 7 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
055	Battery 7 Over voltage	SERVICE NOW
057	Battery 8 Circuit No Voltage	SERVICE SOON
059	Battery 8 Performance	—
060	Battery 8 Out of Range	—
061	Battery 8 Circuit Low Voltage	BATT LIFE

Battery Pack Control Module Diagnostic Trouble Codes (continued)

DTC	Description	Illuminate MIL
062	Battery 8 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
063	Battery 8 Over voltage	SERVICE NOW
065	Battery 9 Circuit No Voltage	SERVICE SOON
067	Battery 9 Performance	—
068	Battery 9 Out of Range	—
069	Battery 9 Circuit Low Voltage	BATT LIFE
070	Battery 9 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
071	Battery 9 Over voltage	SERVICE NOW
073	Battery 10 Circuit No Voltage	SERVICE SOON
075	Battery 10 Performance	—
076	Battery 10 Out of Range	—
077	Battery 10 Circuit Low Voltage	BATT LIFE
078	Battery 10 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
079	Battery 10 Over voltage	SERVICE NOW
081	Battery 11 Circuit No Voltage	SERVICE SOON
083	Battery 11 Performance	—
084	Battery 11 Out of Range	—
085	Battery 11 Circuit Low Voltage	BATT LIFE
086	Battery 11 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
087	Battery 11 Over voltage	SERVICE NOW
089	Battery 12 Circuit No Voltage	SERVICE SOON
091	Battery 12 Performance	—
092	Battery 12 Out of Range	—
093	Battery 12 Circuit Low Voltage	BATT LIFE
094	Battery 12 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
095	Battery 12 Over voltage	SERVICE NOW
097	Battery 13 Circuit No Voltage	SERVICE SOON
099	Battery 13 Performance	—
100	Battery 13 Out of Range	—
101	Battery 13 Circuit Low Voltage	BATT LIFE
102	Battery 13 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
103	Battery 13 Over voltage	SERVICE NOW
105	Battery 14 Circuit No Voltage	SERVICE SOON
107	Battery 14 Performance	—
108	Battery 14 Out of Range	—
109	Battery 14 Circuit Low Voltage	BATT LIFE
110	Battery 14 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
111	Battery 14 Over voltage	SERVICE NOW
113	Battery 15 Circuit No Voltage	SERVICE SOON
115	Battery 15 Performance	—
116	Battery 15 Out of Range	—
117	Battery 15 Circuit Low Voltage	BATT LIFE
118	Battery 15 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
119	Battery 15 Over voltage	SERVICE NOW
121	Battery 16 Circuit No Voltage	SERVICE SOON
123	Battery 16 Performance	—

Battery Pack Control Module Diagnostic Trouble Codes (continued)

DTC	Description	Illuminate MIL
124	Battery 16 Out of Range	—
125	Battery 16 Circuit Low Voltage	BATT LIFE
126	Battery 16 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
127	Battery 16 Over voltage	SERVICE NOW
129	Battery 17 Circuit No Voltage	SERVICE SOON
131	Battery 17 Performance	—
132	Battery 17 Out of Range	—
133	Battery 17 Circuit Low Voltage	BATT LIFE
134	Battery 17 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
135	Battery 17 Over voltage	SERVICE NOW
137	Battery 18 Circuit No Voltage	SERVICE SOON
139	Battery 18 Performance	—
140	Battery 18 Out of Range	—
141	Battery 18 Circuit Low Voltage	BATT LIFE
142	Battery 18 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
143	Battery 18 Over voltage	SERVICE NOW
145	Battery 19 Circuit No Voltage	SERVICE SOON
147	Battery 19 Performance	—
148	Battery 19 Out of Range	—
149	Battery 19 Circuit Low Voltage	BATT LIFE
150	Battery 19 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
151	Battery 19 Over voltage	SERVICE NOW
153	Battery 20 Circuit No Voltage	SERVICE SOON
155	Battery 20 Performance	—
156	Battery 20 Out of Range	—
157	Battery 20 Circuit Low Voltage	BATT LIFE
158	Battery 20 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
159	Battery 20 Over voltage	SERVICE NOW
161	Battery 21 Circuit No Voltage	SERVICE SOON
163	Battery 21 Performance	—
164	Battery 21 Out of Range	—
165	Battery 21 Circuit Low Voltage	BATT LIFE
166	Battery 21 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
167	Battery 21 Over voltage	SERVICE NOW
169	Battery 22 Circuit No Voltage	SERVICE SOON
171	Battery 22 Performance	—
172	Battery 22 Out of Range	—
173	Battery 22 Circuit Low Voltage	BATT LIFE
174	Battery 22 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
175	Battery 22 Over voltage	SERVICE NOW
177	Battery 23 Circuit No Voltage	SERVICE SOON
179	Battery 23 Performance	—
180	Battery 23 Out of Range	—
181	Battery 23 Circuit Low Voltage	BATT LIFE
182	Battery 23 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
183	Battery 23 Over voltage	SERVICE NOW

Battery Pack Control Module Diagnostic Trouble Codes (continued)

DTC	Description	Illuminate MIL
185	Battery 24 Circuit No Voltage	SERVICE SOON
187	Battery 24 Performance	—
188	Battery 24 Out of Range	—
189	Battery 24 Circuit Low Voltage	BATT LIFE
190	Battery 24 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
191	Battery 24 Over voltage	SERVICE NOW
193	Battery 25 Circuit No Voltage	SERVICE SOON
195	Battery 25 Performance	—
196	Battery 25 Out of Range	—
197	Battery 25 Circuit Low Voltage	BATT LIFE
198	Battery 25 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
199	Battery 25 Over voltage	SERVICE NOW
201	Battery 26 Circuit No Voltage	SERVICE SOON
203	Battery 26 Performance	—
204	Battery 26 Out of Range	—
205	Battery 26 Circuit Low Voltage	BATT LIFE
206	Battery 26 Circuit Very Low Voltage	BATT LIFE, SERVICE NOW
207	Battery 26 Over voltage	SERVICE NOW
217	Battery Pack Voltage Out of Range	SERVICE SOON
218	Battery Pack Voltage Out of Range	—
219	Battery Pack Voltage Performance	—
220	Battery Pack Low Voltage	BATT LIFE
221	Battery Pack Extreme Low Voltage	BATT LIFE, SERVICE NOW
222	Battery Pack Extreme Over voltage	SERVICE NOW
227	Class 2 Data Link Low	—
228	Class 2 Data Link High	—
225	Battery Pack Current	SERVICE SOON
230	State of Charge Low	BATT LIFE
231	State of Charge Very Low	BATT LIFE, SERVICE NOW
233	Battery Temperature Sensor 1 High	SERVICE SOON
234	Battery Temperature Sensor 1 Low	SERVICE SOON
235	Battery Temperature Sensor 1 Out of Range	SERVICE SOON
237	Battery Temperature Sensor 2 High	SERVICE SOON
238	Battery Temperature Sensor 2 Low	SERVICE SOON
239	Battery Temperature Sensor 2 Out of Range	SERVICE SOON
241	Battery Temperature Sensor 3 High	SERVICE SOON
242	Battery Temperature Sensor 3 Low	SERVICE SOON
243	Battery Temperature Sensor 3 Out of Range	SERVICE SOON
245	Battery Temperature Sensor 4 High	SERVICE SOON
246	Battery Temperature Sensor 4 Low	SERVICE SOON
247	Battery Temperature Sensor 4 Out of Range	SERVICE SOON
249	Battery Temperature Sensor 5 High	SERVICE SOON
250	Battery Temperature Sensor 5 Low	SERVICE SOON
251	Battery Temperature Sensor 5 Out of Range	SERVICE SOON
253	Battery Temperature Sensor 6 High	SERVICE SOON
254	Battery Temperature Sensor 6 Low	SERVICE SOON

Battery Pack Control Module Diagnostic Trouble Codes (continued)

DTC	Description	Illuminate MIL
255	Battery Temperature Sensor 6 Out of Range	SERVICE SOON
257	Battery Pack Blower Air Flow Sensor 1 Circuit High	—
258	Battery Pack Blower Air Flow Sensor 1 Circuit Low	—
265	Battery Air Inlet Temperature Sensor High	—
266	Battery Air Inlet Temperature Sensor Low	—
267	Battery Thermal Module Air Flow Performance	—
268	Battery Pack Thermal Performance	SERVICE SOON
269	Battery Pack Over Temperature	—
270	Battery Pack Over Temperature When Charging	—
272	Automatic Disconnect Failed to Close	SERVICE NOW, WAIT
273	Automatic Disconnect Open	SERVICE SOON, WAIT
274	Automatic Disconnect Open Battery Pack Control Module Commanded	SERVICE SOON, WAIT
275	Automatic Disconnect High Voltage Interlock Loop Circuit	SERVICE SOON, WAIT
276	Automatic Disconnect Precharge Circuit	SERVICE SOON, WAIT
277	Automatic Disconnect High Voltage Low	SERVICE SOON, WAIT
278	Automatic Disconnect Ground Circuit	SERVICE SOON, WAIT
279	Automatic Disconnect High Voltage Isolation	SERVICE SOON, WAIT
280	Automatic Disconnect Power Supply Circuit Out of Range	SERVICE SOON, WAIT
281	Run 1 Voltage Circuit	—
282	Vehicle Wake Up Circuit	—
285	Park Select Correlation	SERVICE SOON
286	Drive Motor Battery Charger Receptacle Circuit Low	SERVICE SOON
287	Drive Motor Battery Charger Receptacle Circuit Correlation	SERVICE SOON
288	Drive Motor Battery Charger Receptacle Circuit Over temp	TEMP
289	Charge Current Low	—
290	Charge Current High	—
291	Unintended Charging with Charge Paddle	SERVICE SOON
292	Unintended Charging without Charge Paddle	SERVICE SOON
293	Charger Fault	—
294	Charger Communication Fault	—
295	Drive Motor Battery Charge Performance	—
296	HTCM Charge Inhibit	—
300	HTCM Communication	—
301	Drive Motor Control Module Communication	—
302	Battery Pack Control Module Reset	SERVICE NOW (FLASH)
303	Battery Pack Control Module Circuit	SERVICE NOW (FLASH)
304	Battery Pack Control Module Keep Alive Memory	SERVICE NOW (FLASH)
305	Battery Pack Control Module Circuit	SERVICE SOON
306	Battery Pack Control Module Circuit	SERVICE SOON
307	Battery Pack Control Module Circuit	SERVICE SOON
308	Battery Pack Control Module Circuit	SERVICE SOON
309	Battery Pack Reference Voltage Out of Range	SERVICE SOON
310	Accessory Voltage Circuit High	SERVICE SOON
311	Accessory Voltage Circuit Low	SERVICE SOON
312	Battery Pack Control Module Circuit Voltage High	SERVICE SOON

DTC 001, 009, 017, 025, 033, 041, 049, 057, 065, 073, 081, 089, 097, 105, 113, 121, 129, 137, 145, 153, 161, 169, 177, 185, 193, 201, Battery 1- 26 Circuit No Voltage

Circuit Description

The battery pack assembly consists of 26 individual battery modules wired in series. Each of these modules has a sense lead which enables the Battery Pack Control Module to read the voltage of each battery module. The Battery Pack Control Module measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the modules sense lead, the negative reference is taken from the next modules sense lead except for battery 26. Each module voltage is read every 50 milliseconds, therefore taking 1.5 minutes to read all 26 battery module voltages.

Conditions for Setting the DTC

- Battery voltage sense circuit is below 1 volt.
- DTC 310, 311, 312, 305, 309 not set.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.
- After 3 or more batteries fall into DTC setting conditions the Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light and the vehicle will be charged.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will switch from current to history and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles if no other DTC(s) are set.
- DTC(s) can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks that the fault is current.

Battery 1- 26 Circuit No Voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Have 3 battery modules set Circuit No Voltage DTCs causing the SERVICE SOON lamp to turn ON?	—	Go to Step 4	Go to Step 3
3	Phone Technical Assistance	—	Go to Step 5	Go to Step 5
4	Repair the battery Pack. Refer to: *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

Battery DTC Reference Table

DTC	Battery #	DTC	Battery #	DTC	Battery #	DTC	Battery #
001	1	057	8	113	15	169	22
009	2	065	9	121	16	177	23
017	3	073	10	129	17	185	24
025	4	081	11	137	18	193	25
033	5	089	12	145	19	201	26
041	6	097	13	153	20		
049	7	105	14	161	21		

DTC 003, 011, 019, 027, 035, 043, 051, 059, 067, 075, 083, 091, 099, 107, 115, 123, 131, 139, 147, 155, 163, 171, 179, 187, 195, 203 Battery 1- 26 Performance

Circuit Description

The battery pack assembly consists of 26 individual battery modules wired in series. Each of these modules has a sense lead which enables the Battery Pack Control Module to read the voltage of each battery module. The Battery Pack Control Module measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the modules sense lead, the negative reference is taken from the next modules sense lead. Each module voltage is read every 50 ms, therefore taking 1.5 minutes to read all 26 battery module voltages.

Conditions for Setting the DTC

- Battery pack is above 15% true SOC.
- Battery Pack Control Module DTC(s) 219, 217, 218, or 225 are not set.
- Current usage is greater than 20 amps.
- The Battery Pack Control Module detects 100 occurrences of a voltage difference of 0.6 volts from the average battery module voltage.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will switch from current to history.
- The DTC will clear from history after 100 power cycles.
- DTC(s) can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- In order for each battery module to maintain a potential for maximum capacity it is important to allow the battery pack to complete the equalization process during charging.
- It may be necessary to drive the vehicle to duplicate the fault conditions.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Note all performance DTC(s) for use by the battery pack technician.

Battery 1- 26 Performance

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	This DTC is used for reference during battery pack service. Include a record of all performance DTC(s) in transmittal to the pack service technician.	—	Go to OBD System Check	—

Battery DTC Reference Table

DTC	Battery #	DTC	Battery #	DTC	Battery #	DTC	Battery #
003	1	059	8	115	15	171	22
011	2	067	9	123	16	179	23
019	3	075	10	131	17	187	24
027	4	083	11	139	18	195	25
035	5	091	12	147	19	203	26
043	6	099	13	155	20		
051	7	107	14	163	21		

DTC 004, 012, 020, 028, 036, 044, 052, 060, 068, 076, 084, 092, 100, 108, 116, 124, 132, 140, 148, 156, 164, 172, 180, 188, 196, 204 Battery 1- 26 Out Of Range

Circuit Description

The battery pack assembly consists of 26 individual battery modules wired in series. Each of these modules has a sense lead which enables the Battery Pack Control Module to read the voltage of each battery module. The Battery Pack Control Module measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the modules sense lead, the negative reference is taken from the next modules sense lead. Each module voltage is read every 50 ms, therefore taking 1.5 minutes to read all 26 battery module voltages.

Conditions for Setting the DTC

- Battery pack is above 15% true SOC.
- Battery Pack Control Module DTC(s) 219, 217, 218, or 225 are not set.
- Current usage is greater than 20 amps.
- The Battery Pack Control Module detects 100 occurrences of a voltage difference of 1 volt from the average battery module voltage.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will switch from current to history and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Allow the battery pack to charge to complete.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Note all Out of Range DTC(s) for use by the battery pack technician.

DTC 004 Battery 1- 26 Out Of Range

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	This DTC is used for reference during battery pack service. Include a record of all Out of Range DTC(s) in transmittal to the pack service technician.	—	Go to OBD System Check	—

Battery DTC Reference Table

DTC	Battery #	DTC	Battery #	DTC	Battery #	DTC	Battery #
004	1	060	8	116	15	172	22
012	2	068	9	124	16	180	23
020	3	076	10	132	17	188	24
028	4	084	11	140	18	196	25
036	5	092	12	148	19	204	26
044	6	100	13	156	20		
052	7	108	14	164	21		

DTC 005, 013, 021, 029, 037, 045, 053, 061, 069, 077, 085, 093, 101, 109, 117, 125, 133, 141, 149, 157, 165, 173, 181, 189, 197, 205 Battery 1- 26 Circuit Low Voltage

Circuit Description

The battery pack assembly consists of 26 individual battery modules wired in series. Each of these modules has a sense lead which enables the Battery Pack Control Module to read the voltage of each battery module. The Battery Pack Control Module measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the modules sense lead, the negative reference is taken from the next modules sense lead. Each module voltage is read every 50 ms, therefore taking 1.5 minutes to read all 26 battery module voltages.

Conditions for Setting the DTC

- The battery(s) voltage has dropped below a value determined by battery current for continuously for 45 seconds.

Current	Voltage	Current	Voltage
0	11.75	-220	9.60
-20	11.10	-240	9.52
-40	10.90	-260	9.48
-60	10.65	-280	9.44
-80	10.45	-300	9.31
-100	10.30	-320	9.17
-120	10.15	-340	9.03
-140	10.00	-360	8.87
-160	9.90	-380	8.73
-180	9.8	-400	8.59
-200	9.7		

Action Taken When the DTC Sets

- Battery Pack Control Module will illuminate the BATT LIFE lamp.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will clear from current.
- BATT LIFE will not clear until the vehicle has been charged for 30 minutes and true SOC is greater than 50% or a Battery Pack Control Module power down has been complete.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- This DTC can set if vehicle is driven below 0% user SOC (15% true SOC), especially under high loads. This does not indicate a failure.
- Drive the vehicle under the same conditions and see if the DTC will reset.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. If the DTC resets at a USOC of 0% or lower this is a normal condition.
5. This step checks charge event history records.
6. This step verifies pack capacity.

Battery 1- 26 Circuit Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Charge the vehicle to COMPLETE. Was the vehicle able to be charged?	—	Go to Step 3	Go to Step 8
3	1. Drive the vehicle until the DTC resets. 2. Note the condition when the DTC reset. 3. Recharge the vehicle to COMPLETE. Was the state of charge at or below the specified value when the DTC reset?	0% USOC 15% True SOC	Go to Step 4	Go to Step 5
4	Was the vehicle range typical considering the driving conditions and temperature?	—	Go to Step 9	Go to Step 6
5	1. Connect a scan tool. 2. View the vehicle charge event history records. Did the last four charge event history records show the vehicle has been charged to complete?	—	Go to Step 6	Go to Step 7
6	Perform a battery pack discharge test but do NOT replace any battery modules. Refer to *Battery pack discharge test* in this section.	—	—	—
7	1. Clear DTC'S. Refer to Clearing *Diagnostic Trouble Codes.* 2. Return the vehicle to the customer with instructions to discharge and charge the vehicle to COMPLETE four consecutive times.	—	—	—
8	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 10	—
9	Inform the customer that this is a normal condition when the vehicle is discharged below the specified value. Is the action complete?	0% USOC 15% True SOC	Go to Step 10	—
10	Clear DTC's. Refer to *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

Battery DTC Reference Table

DTC	Battery #	DTC	Battery #	DTC	Battery #	DTC	Battery #
005	1	061	8	117	15	173	22
013	2	069	9	125	16	181	23
021	3	077	10	133	17	189	24
029	4	085	11	141	18	197	25
037	5	093	12	149	19	205	26
045	6	101	13	157	20		
053	7	109	14	165	21		

DTC 006, 014, 022, 030, 038, 046, 054, 062, 070, 078, 086, 094, 102, 110, 118, 126, 134, 142, 150, 158, 166, 174, 182, 190, 198, 206 Battery 1- 26 Circuit Very Low Voltage

Circuit Description

The battery pack assembly consists of 26 individual battery modules wired in series. Each of these modules has a sense lead which enables the Battery Pack Control Module to read the voltage of each battery module. The Battery Pack Control Module measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the modules sense lead, the negative reference is taken from the next modules sense lead. Each module voltage is read every 50 ms, therefore taking 1.5 minutes to read all 26 battery module voltages.

Conditions for Setting the DTC

- The battery(s) voltage has dropped below the voltage vs. current table and the condition is present continuously for 30 seconds.

Current	Voltage	Current	Voltage
0	11.45	-220	8.90
-20	10.55	-240	8.82
-40	10.20	-260	8.78
-60	9.95	-280	8.74
-80	9.75	-300	8.70
-100	9.60	-320	8.66
-120	9.45	-340	8.58
-140	9.30	-360	8.43
-160	9.20	-380	8.28
-180	9.10	-400	8.14
-200	9.00		

Action Taken When the DTC Sets

- Battery Pack Control Module will illuminate the BATT LIFE light.
- Battery Pack Control Module will illuminate the SERVICE NOW light.
- Performance will be reduced.
- Propulsion will be disabled after the vehicle is driven less then 1 kph for 180 seconds or the vehicle is placed in park for 10 seconds.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will switch from current to history and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- BATT LIFE will not clear until the vehicle has been charged for 30 minutes and true SOC is greater than 50% or a Battery Pack Control Module power down has been completed.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- This DTC can set if vehicle is driven below 0% true SOC, especially under high loads. This does not indicate a failure.
- Drive the vehicle under the same conditions and see if the DTC will reset.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. If the DTC resets at a USOC of 0% or lower this is a normal condition.
5. This step checks charge event history records.
6. This step verifies pack capacity.

Battery 1- 26 Circuit Very Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Charge the vehicle to COMPLETE. Was the vehicle able to be charged?	—	Go to Step 3	Go to Step 8
3	1. Drive the vehicle until the DTC resets. 2. Note the condition when the DTC reset. 3. Recharge the vehicle to COMPLETE. Was the state of charge at or below the specified value when the DTC reset?	0% USOC 15% True SOC	Go to Step 4	Go to Step 5
4	Was the vehicle range typical considering the driving conditions and temperature?	—	Go to Step 9	Go to Step 6
5	1. Connect a scan tool. 2. View the vehicle charge event history records. Did the last four charge event history records show the vehicle has been charged to complete?	—	Go to Step 6	Go to Step 7
6	Perform a battery pack discharge test but do NOT replace any battery modules. Refer to *Battery pack discharge test* in this section.	—	—	—
7	1. Clear DTC'S. Refer to Clearing *Diagnostic Trouble Codes.* 2. Return the vehicle to the customer with instructions to discharge and charge the vehicle to COMPLETE four consecutive times.	—	—	—
8	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 10	—
9	Inform the customer that this is a normal condition when the vehicle is discharged below the specified value. Is the action complete?	0% USOC 15% True SOC	Go to Step 10	—
10	Clear DTC's. Refer to *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

Battery DTC Reference Table

DTC	Battery #	DTC	Battery #	DTC	Battery #	DTC	Battery #
006	1	062	8	118	15	174	22
014	2	070	9	126	16	182	23
022	3	078	10	134	17	190	24
030	4	086	11	142	18	198	25
038	5	094	12	150	19	206	26
046	6	102	13	158	20		
054	7	110	14	166	21		

DTC 007, 015, 023, 031, 039, 047, 055, 063, 071, 079, 087, 095, 103, 111, 119, 127, 135, 143, 151, 159, 167, 175, 183, 191, 199, 207 Battery 1- 26 Over Voltage

Circuit Description

The Drive Motor Battery Assembly consists of 26 individual battery modules wired in series. Each of these modules has a sense lead which enables the Battery Pack Control Module to read the voltage of each battery module. The Battery Pack Control Module measures the voltage by allowing a capacitor to be charged and then the voltage across the capacitor is measured. The battery module positive voltage reference is from the modules sense lead, the negative reference is taken from the next modules sense lead. Each module voltage is read every 50 ms, therefore taking 1.5 minutes to read all 26 battery module voltages.

Conditions for Setting the DTC

During Propulsion:

- Battery Pack Control Module sees a module 3 volts greater than the set module voltage for 30 seconds. (The set module voltage is a calculated module voltage based on temperature.)

During Charging:

- Battery Pack Control Module sees a module 1.5 volts greater than the set module voltage for 30 seconds.

Action Taken When the DTC Sets

- Battery Pack Control Module will illuminate the SERVICE NOW light.
- Performance will be reduced.
- During charging the auto disconnect relays will be commanded open if the charger does not respond to the Battery Pack Control Module request for 0 power within 10 seconds.
- Regeneration is disabled until the Battery Pack Control Module goes through a power down.
- The automatic disconnect will open after 180 seconds of vehicle speed less than 1 kph or 10 seconds in park if the regeneration feature is unable shut down after 5 seconds.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will switch from current to history and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- This DTC is typically caused by an imbalance in the battery pack. Using a scan tool command leveling and let the battery pack charge to completion. Drive the vehicle and verify the DTC does not reset.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the DTC is current the battery pack requires service.

Battery 1- 26 Over Voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the DTC current?	—	Go to Step 3	Go to Diagnostic Aids
3	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

Battery DTC Reference Table

DTC	Battery #	DTC	Battery #	DTC	Battery #	DTC	Battery #
007	1	063	8	119	15	175	22
015	2	071	9	127	16	183	23
023	3	079	10	135	17	191	24
031	4	087	11	143	18	199	25
039	5	095	12	151	19	207	26
047	6	103	13	159	20		
055	7	111	14	167	21		

DTC 217 Battery Pack Voltage Out of Range

Circuit Description

The battery pack is separated into two sections each containing 13 batteries. The Battery Pack Control Module uses two sense lines, one from module 1 and the other from module 26, to read total pack voltage. This pack voltage is read by referencing modules on each side of the shunt low reference. This battery pack voltage is compared to the sum of 26 battery modules to ensure proper operation.

Conditions for Setting the DTC

- Voltage as sensed by the Battery Pack Control Module is less than 208, and greater than the sum of battery 1-14 voltages or battery pack voltage is below 5 volts.
- Current is ± 20 amps.
- DTC(s) 305, 309, 310, 311 or 312 are not set.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Charging is disabled.
- The sum of 26 battery voltages will be used for pack voltage.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will switch to history and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- Review scan tool data.
- Refer to any open battery module DTC(s) first.
- Check for poor connections due to loose battery terminal nuts before replacing and components.
- If DTC 217 is set the Battery Pack Control Module will use the sum of the 26 individual modules for its control voltage.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. All Battery Pack Control Module DTC(s) should be diagnosed first.
3. Checks the fault is present.

DTC 217 Battery Pack Voltage Out of Range

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any Battery Pack Control Module DTC(s) 1-216 or 305, 309, 310, 311 or 312 set?	—	Go to other DTCs first	Go to Step 3
3	1. Using a scan tool record all current and history DTC(s). 2. Clear all DTC(s). 3. Turn the ignition ON. 4. Drive the vehicle using at least 20 amps of power. 5. Check For DTC(s). Did Battery Pack Control Module DTC 217 reset?	30 seconds	Go to Step 4	Go to Diagnostic Aids
4	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 218 Battery Pack Voltage Out of Range

Circuit Description

The battery pack is separated into two sections each containing 13 batteries. The Battery Pack Control Module uses two sense lines, one from module 1 and the other from module 26, to read total pack voltage. This pack voltage is read by referencing modules on each side of the shunt low reference. This battery pack voltage is compared to the sum of 26 battery modules to ensure proper operation.

Conditions for Setting the DTC

- Battery Pack Control Module sensed voltage is less than the sum of battery module voltage on batteries (1-13) + 5 Volts.
- Current is ± 20 amps.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will switch from current to history and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- Review scan tool data.
- Refer to any open battery module DTC(s) first.
- Check for poor connections due to loose battery terminal nuts before replacing and components.
- If DTC 217 is set the Battery Pack Control Module will use the sum of the 26 individual modules for its control voltage.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. All Battery Pack Control Module DTC(s) should be diagnosed first.
3. Checks the fault is present.

DTC 218 Battery Pack Voltage Out of Range

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any Battery Pack Control Module DTC(s) 1-216 set?	—	Go to other DTCs first	Go to Step 3
3	1. Using a scan tool record all current and history DTC(s). 2. Clear all DTC(s). 3. Turn the ignition ON. 4. Drive the vehicle using at least 20 amps of power. 5. Check For DTC(s). Did Battery Pack Control Module DTC 218 reset?	30 seconds	Go to Step 4	Go to Diagnostic Aids
4	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 219 Battery Pack Voltage Performance

Circuit Description

The Battery Pack Control Module measures the voltage across all 26 batteries. It takes the value of the lowest individual battery module and multiples it by 26. The same is done for the highest module. The Battery Pack Control Module then compares the measured value pack voltage to the calculated window of the lowest and highest possible pack voltage. If the pack voltage does not fall between the window the DTC will set.

Conditions for Setting the DTC

- The battery pack control module sensed battery pack voltage does not equal the sum of the battery module voltages.
- Lowest and highest battery calculations are within a calibrated window.
  - 26X lowest module voltage -3 volts = (minimum voltage).
  - 26X highest module voltage +3 volts = (maximum voltage).
- Conditions must be present for 45 second at ± 20 amps.
- Battery Pack Control Module DTC(s) 217 and 218, 305, 309, 310, 311 or 312 are not set.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Charging is disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will switch to history and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Review scan tool data.
- This DTC will not set if Battery Pack Control Module DTC 217 or 218 are set.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. These Battery Pack Control Module DTC(s) should be diagnosed first.
3. Checks that the fault is present.

DTC 219 Battery Pack Voltage Performance

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any other Battery Pack Control Module DTC(s)set?	—	Go to other DTCs first	Go to Step 3
3	1. Using a scan tool record all current and history DTC(s). 2. Clear all DTC(s). 3. Turn the ignition ON. 4. Drive the vehicle using at least 20 amps of power. 5. Check For DTC(s). Did Battery Pack Control Module DTC 219 reset?	30 seconds	Go to Step 4	Go to Diagnostic Aids
4	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 220 Battery Pack Low Voltage

Circuit Description

The Battery Pack Control Module monitors the voltage of the battery pack using Pack-HI and Pack-LO inputs from modules #1 and #26. This voltage is used to track the actual available voltage in the battery pack.

Conditions for Setting the DTC

- The battery pack sensed voltage falls below the voltage vs. current table continuously for 45 seconds.

Current	Voltage	Current	Voltage
0	305.5	-220	249.6
-20	288.6	-240	247.5
-40	283.4	-260	246.5
-60	276.9	-280	245.4
-80	271.7	-300	244.4
-100	267.8	-320	243.4
-120	263.9	-340	242.3
-140	260.0	-360	241.3
-160	257.4	-380	240.2
-180	254.8	-400	239.2
-200	252.2		

Action Taken When the DTC Sets

- Battery Pack Control Module will illuminate the BATT LIFE lamp.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will switch to history and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- BATT LIFE will not clear until the vehicle has been charged for 30 minutes and true SOC is greater than 50% or a Battery Pack Control Module power down has been complete.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Review scan tool data.
- This DTC can set if the vehicle is driven after it reaches 0% user SOC. This indicates a normal condition and the vehicle should be charged.
- If a problem exists with the PACK HI or PACK LO circuit DTC(s) 217 and/or 218 will be set.
- Battery module low voltage DTC should set before Battery Pack Control Module DTC 220.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks that the DTC is current.
4. Driving after 0% SOC will set this DTC normally.

DTC 220 Battery Pack Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are Battery Pack Control Module DTC(s) 1-207 or 217, 218 set?	—	Go to other DTCs first	Go to Step 3
3	1. Using a scan tool record all current and history DTC(s). 2. Clear all DTC(s). 3. Turn the ignition ON. 4. Drive the vehicle and allow pack current to reach the proper value specified in the voltage vs. current table. 5. Check For DTC(s). Did the DTC reset?	30 seconds	Go to Step 4	Go to Diagnostic Aids
4	Did the DTC set when SOC was at or below the specified value?	0% user SOC 15% true SOC	Go to Step 5	Go to Step 6
5	1. Charge the vehicle to COMPLETE. 2. Clear DTC(s). 3. Cycle the key off the on again. 4. Drive the vehicle and allow pack current to reach the proper value specified in the voltage vs. current table. Did the DTC reset?	—	Go to Step 6	Go to Step 7
6	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 221 Battery Pack Extreme Low Voltage

Circuit Description

The Battery Pack Control Module monitors the voltage of the battery pack using Pack-HI and Pack-LO inputs from modules #1 and #26. This voltage is used to track the actual available voltage in the battery pack.

Conditions for Setting the DTC

- The battery pack sensed voltage falls below a value determined by current flow continuously for 30 seconds.

Current	Voltage	Current	Voltage
0	297.7	-220	231.4
-20	274.3	-240	229.3
-40	265.2	-260	228.3
-60	258.7	-280	227.2
-80	253.5	-300	226.2
-100	249.6	-320	225.2
-120	245.7	-340	224.1
-140	241.8	-360	223.1
-160	239.2	-380	222.0
-180	236.6	-400	221.0
-200	234.0		

Action Taken When the DTC Sets

- The battery Pack Control Module will illuminate the BATT LIFE light.
- The battery pack control module will illuminate the SERVICE NOW light.
- Performance will be reduced.
- Propulsion will be disabled when:
  - The vehicle speed is less than 1 km/h for 180 seconds.
  - The vehicle is in park for 10 seconds.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will switch to history and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- BATT LIFE light will not clear until the vehicle has been charged for 30 minutes and true SOC is greater than 50% or Battery Pack Control Module power down has been completed.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Review scan tool data.
- This DTC can set if the vehicle is driven after it reaches 0% true SOC. This indicates a normal condition and the vehicle should be charged.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks that the DTC is current.
4. Driving after 0% SOC will set this DTC normally.

DTC 221 Battery Pack Extreme Low Voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are Battery Pack Control Module DTC(s) 217 or 218 set?	—	Go to other DTCs first	Go to Step 3
3	1. Using a scan tool record all current and history DTC(s). 2. Clear all DTC(s). 3. Turn the ignition ON. 4. Drive the vehicle and allow pack current to reach the proper value specified in the voltage vs. current table. 5. Check For DTC(s). Did Battery Pack Control Module DTC 220 reset?	30 seconds	Go to Step 4	Go to Diagnostic Aids
4	Did the DTC set when SOC was at the specified value?	0% user SOC 15% true SOC	Go to Step 5	Go to Step 6
5	Charge the vehicle to completion. Is the action complete?	100% SOC	Go to Step 7	Go to *Vehicle will not charge*
6	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 222 Battery Pack Extreme Over voltage

Circuit Description

The Battery Pack Control Module monitors the voltage of the battery pack using Pack-HI and Pack-LO inputs from modules #1 and #26. During Charging or regeneration the Battery Pack Control Module will select a maximum operation voltage based on temperature. This voltage defines the highest pack voltage acceptable without setting a DTC.

Conditions for Setting the DTC

- This DTC will set anytime the battery voltage exceeds the voltage lid plus 10 volts for 10 seconds.

Action Taken When the DTC Sets

- The battery Pack Control Module will illuminate the BATT LIFE light.
- The battery pack control module will illuminate the SERVICE NOW light.
- Performance will be reduced.
- Regeneration is disabled until Battery Pack Control Module power down.
- If charging the auto disconnect relays are opened if the charger does not respond to Zero(0) current request.
- Charging is disabled.

Conditions for Clearing the DTC

- If the fault conditions for the DTC are no longer present the DTC will switch from current and the vehicle will return to normal operation.
- BATT LIFE light will not clear until the vehicle has been charged for 30 minutes and true SOC is greater than 50% or Battery Pack Control Module power down has been completed.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- View scan tool data.
- View the charger event history tables to determine the conditions the DTC set under.
- If the DTC set during charging, check the charger for correct output and type of charger.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks that the DTC is current.

DTC 222 Battery Pack Extreme Over voltage

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are Battery Pack Control Module DTC(s) 217, 218 or 286 to 296 set?	—	Go to other DTC(s) first	Go to Step 3
3	1. Using a scan tool record all current and history DTC(s). 2. Clear all DTC(s). 3. Cycle the vehicle OFF then ON. 4. Drive the vehicle and allow pack current to reach the proper value specified in the voltage vs. current table. 5. Check For DTC(s). Did Battery Pack Control Module DTC 222 reset?	30 seconds	Go to Step 4	Go to Diagnostic Aids
4	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 225 Battery Pack Current

Circuit Description

The Battery Pack Control Module monitors the battery current through a shunt. The shunt splits the battery pack down to 13 batteries on the shunt high (positive) and 13 batteries on the shunt low (negative) side.

Conditions for Setting the DTC

This DTC will set anytime the current is :

- ± 400 amps for 120 seconds
- ± 443 amps for 0.5 seconds
- DTC(s) 305, 309, 310, 311 or 312 are not set.

Action Taken When the DTC Sets

- When the DTC fault conditions are met for five seconds the USOC gauge on dash will switch between 0 and estimated SOC.
- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Charging is disabled.
- Power use gauge will default to zero (0).
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current and move to history. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- View scan tool data.
- SOC information may not be accurate when this DTC is set.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

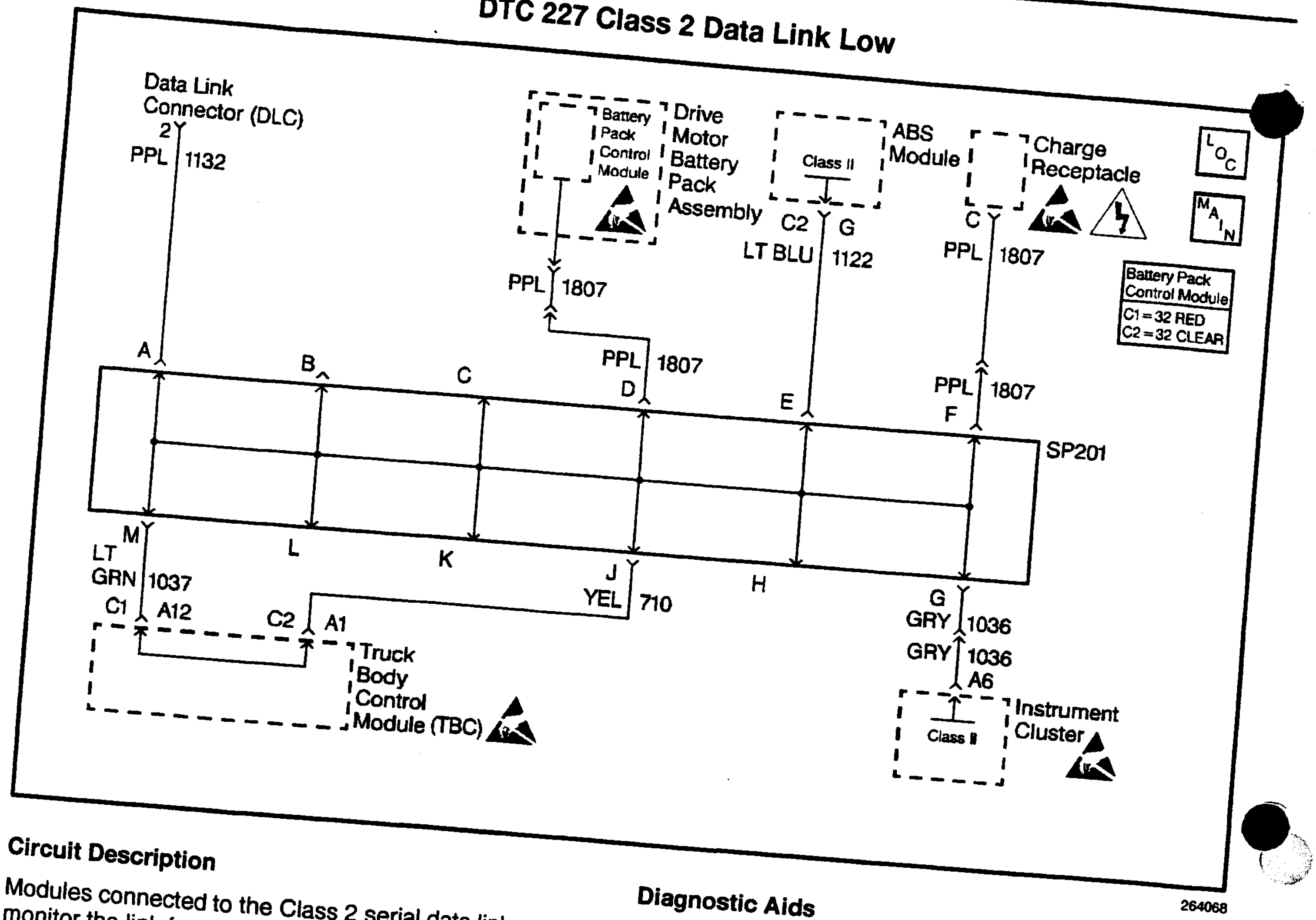
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks that the fault is present.

DTC 225 Battery Pack Current

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Using a scan tool record all current and history DTC(s). 2. Clear all DTC(s). 3. Cycle the vehicle OFF then ON. 4. Check For DTC(s). Did Battery Pack Control Module DTC 225 reset?	30 seconds	Go to Step 3	Go to Diagnostic Aids
3	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 227 Class 2 Data Link Low


Data Link Connector (DLC)
2
PPL
1132
Battery Pack Control Module
Drive Motor Battery Pack Assembly
PPL
1807
Class II
ABS Module
C2
G
LT BLU
1122
Charge Receptacle
C
PPL
1807
LOC
MAIN
Battery Pack Control Module
C1 = 32 RED
C2 = 32 CLEAR
A
B
C
PPL
1807
D
E
PPL
1807
F
SP201
M
LT GRN
1037
L
K
J
YEL
710
H
G
GRY
1036
GRY
1036
A6
C1
A12
C2
A1
Truck Body Control Module (TBC)
Class II
Instrument Cluster
264068

Circuit Description

Modules connected to the Class 2 serial data link monitor the link for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the modules. The DTC will set when the module detects no messages and a low voltage on the Class 2 serial data link.

Conditions for Setting the DTC

- Class 2 Data circuit is shorted to ground.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.
- Class 2 data will not be available.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current and move to history. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.
- A grounded serial data line will pull the entire circuit low and not allow any communication.

Test Description

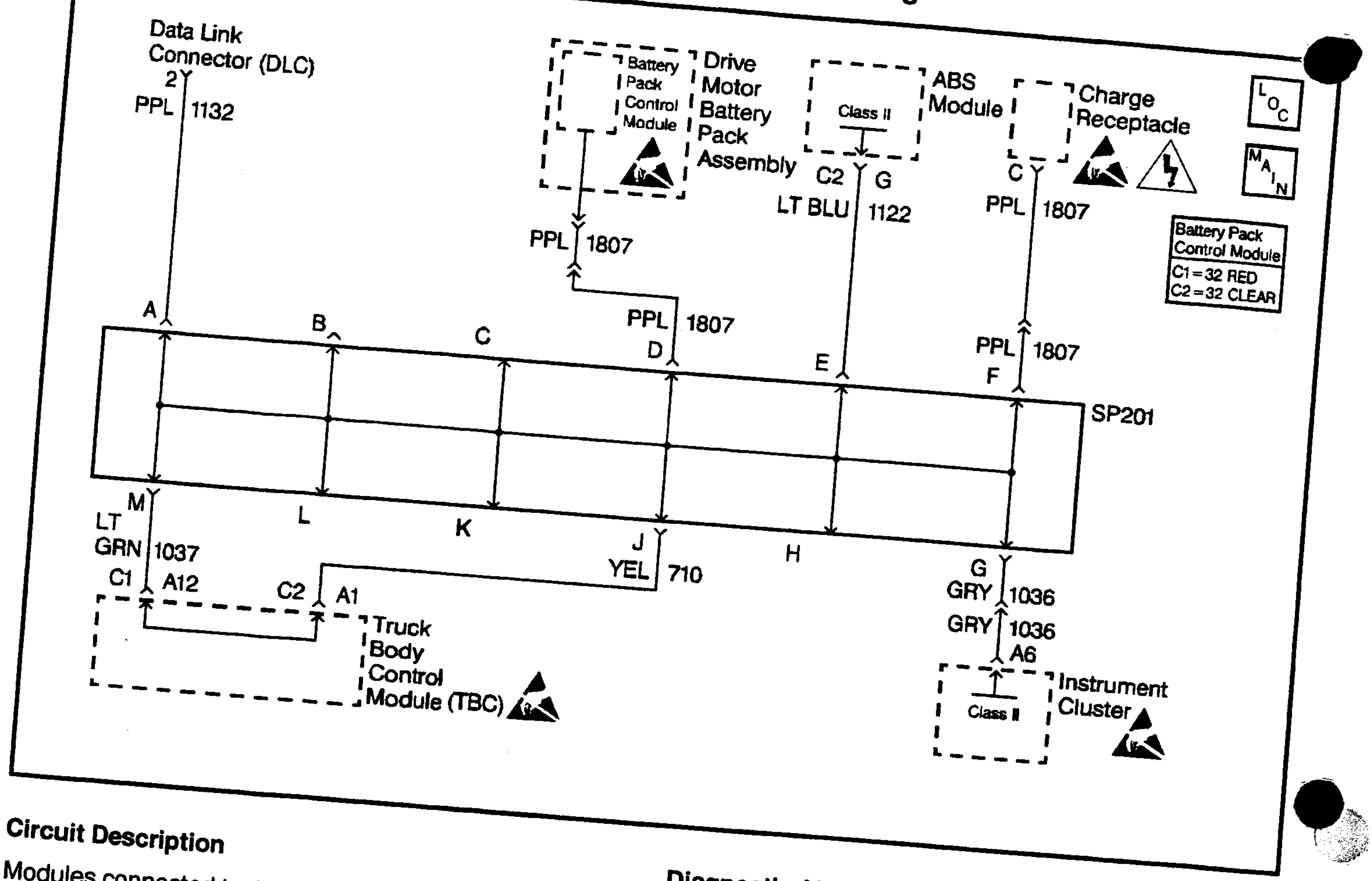
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks the circuit for a short to ground.

DTC 227 Class 2 Data Link Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition Switch to Run. 2. Using a scan tool attempt to communicate over the Class 2 data circuit with the I/P Cluster, Truck Body Control Module and the ABS Module. Is Class 2 data communication present?	—	Go to Step 4	Go to step 3
3	Refer to *Data Link Connector* diagnosis in *Electrical Diagnosis.*	—	—	—
4	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 228 Class 2 Data Link High


Data Link Connector (DLC)
2
PPL
1132
Battery Pack Control Module
Drive Motor Battery Pack Assembly
PPL
1807
PPL
1807
Class II
ABS Module
C2
G
LT BLU
1122
Charge Receptacle
C
PPL
1807
PPL
1807
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
A
B
C
D
E
F
SP201
M
LT GRN
1037
L
K
J
YEL
710
H
G
GRY
1036
GRY
1036
A6
C1
A12
C2
A1
Truck Body Control Module (TBC)
Class II
Instrument Cluster

264068

Circuit Description

Modules connected to the Class 2 serial data link monitor the link for serial data communications during normal vehicle operation. Operating information and commands are exchanged among the modules. The DTC will set when the module detects no messages and a high voltage on the Class 2 serial data link.

Conditions for Setting the DTC

- Class 2 Data circuit is shorted to voltage or open.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.
- Class 2 data will not be available.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current and move to history. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.
- A short to voltage or an open circuit will pull the entire circuit high and will not allow any communication.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step verifies the presence of Class 2 Data.
4. This step checks for an open circuit outside the pack.

DTC 228 Class 2 Data Link High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the Ignition Switch to Run. 2. Using a scan tool attempt to communicate over the Class 2 data circuit with the I/P Cluster, Truck Body Control Module and the ABS Module. Is Class 2 data communication present?	—	Go to Step 4	Go to step 3
3	Refer to *Data Link Connector* diagnosis in *Electrical Diagnosis.*	—	—	—
4	Check for an open in circuit 1807 between SP201 and the 20 Way Connector to the Battery Pack. Was a open found?	—	Go to Step 6	Go to Step 5
5	Check for an open in circuit 1807 between Battery Pack Control Module Connector and the 20 Way Connector to the Battery Pack. Was a open found?	—	Go to Step 6	Go to Step 7
6	Repair the wiring harness as required. Refer to *Repair Procedures* in *Electrical Diagnosis.* Is the repair complete?	—	Go to Step 8	—
7	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 8	—
8	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 230 State of Charge Low

Circuit Description

The Battery Pack Control Module monitors the current and voltage to establish the state of charge of the battery pack. This information is displayed on the User State Of Charge gauge to indicate the level of charge in the battery pack.

Conditions for Setting the DTC

- User State Of Charge = 0% for 10 seconds.

Action Taken When the DTC Sets

- The battery pack control module will illuminate the BATT LIFE light.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current and move to history. The vehicle will then return to normal operation.
- BATT LIFE light will not clear until the vehicle has been charged for 30 minutes and true SOC is greater than 50% or Battery Pack Control Module power down has been completed.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The vehicle needs to be charged.
- View scan tool data.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This indicates the batteries need to be charged.

DTC 230 State of Charge Low

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault present?	—	Go to Step 3	Go to Diagnostic Aids
3	Charge the vehicle to completion. Is the action complete?	—	Go to Step 4	Go to *Vehicle will not charge*
4	Clear DTC's. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 231 State of Charge Very Low

Circuit Description

The battery pack module monitors the state of charge present in the battery pack. After the pack is charged to completion the battery pack true state of charge value is reduced by 15% and displayed on the instrument panel state of charge gauge. Because of this feature when the state of charge gauge reads zero, the battery pack still holds a 15% actual state of charge.

Conditions for Setting the DTC

- True state of charge has fallen below 10% for 10 seconds.

Action Taken When the DTC Sets

- The battery pack Control Module will illuminate the BATT LIFE light.
- The battery pack control module will illuminate the SERVICE NOW light.
- Performance will be reduced.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- BATT LIFE light will not clear until the vehicle has been charged for 30 minutes and true SOC is greater than 50% or Battery Pack Control Module power down has been completed.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- View scan tool data.
- This DTC will set if the vehicle is driven after reaching 0% user SOC as read by the vehicle SOC gauge.
- The vehicle should be charged to completion.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This DTC does not indicate a failure.

DTC 231 State of Charge Very Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	This DTC does not indicate a failure. Refer to other stored DTC(s). If no other DTC(s) are present, charge the vehicle and test drive. Is the action complete?	—	Go to Step 3	—
3	Clear DTC's. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 233 Battery Temperature Sensor 1 High

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #1 is below -19°C (-2°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only if two of the six temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- View scan tool data.
- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 233 Battery Temperature Sensor 1 High

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 234 Battery Temperature Sensor 1 Low

ircuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #1 is above 75°C (167°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only if two of the six temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.
6. Checks the harness and sensor to verify the Battery Pack Control Module reading.

DTC 234 Battery Temperature Sensor 1 Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 235 Battery Temperature Sensor 1 Out of Range

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Temperature sensor #1 is reading 15°C (27°F) higher or lower the pack average temperature.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only if two of the six temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- View scan tool data.
- Insure that the temperature sensor is attached to the battery properly.
- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Temperature vs Resistance Values (Approximate)		
-40	-40	100544
-35	-31	72206
-30	-22	52426
-25	-13	38460
-20	-4	28491
-15	5	21302
-10	14	16068
-5	23	12221
0	32	9370
5	41	7240
10	50	5640
15	59	4427
20	68	3500
25	77	2786
30	86	2232
35	95	1800
40	104	1460
45	113	1191
50	122	977.1
55	131	806.2
60	140	668.7
65	149	557.6
70	158	467.2

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 235 Battery Temperature Sensor 1 Out of Range

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 237 Battery Temperature Sensor 2 High

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #2 is below -19°C (-2°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 237 Battery Temperature Sensor 2 High

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 238 Battery Temperature Sensor 2 Low

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #2 is above 75°C (167°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 238 Battery Temperature Sensor 2 Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 239 Battery Temperature Sensor 2 Out of Range

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

Temperature sensor #2 is reading 15°C (27°F) higher or lower the pack average temperature.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	100544
-35	-31	72206
-30	-22	52426
-25	-13	38460
-20	-4	28491
-15	5	21302
-10	14	16068
-5	23	12221
0	32	9370
5	41	7240
10	50	5640
15	59	4427
20	68	3500
25	77	2786
30	86	2232
35	95	1800
40	104	1460
45	113	1191
50	122	977.1
55	131	806.2
60	140	668.7
65	149	557.6
70	158	467.2

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 239 Battery Temperature Sensor 2 Out of Range

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 241 Battery Temperature Sensor 3 High

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #3 is below -19°C (-2°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 241 Battery Temperature Sensor 3 High

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 242 Battery Temperature Sensor 3 Low

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #3 is above 75°C 167°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 242 Battery Temperature Sensor 3 Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 243 Battery Temperature Sensor 3 Out of Range

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

Temperature sensor #3 is reading 15°C (27°F) higher or lower the pack average temperature.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	100544
-35	-31	72206
-30	-22	52426
-25	-13	38460
-20	-4	28491
-15	5	21302
-10	14	16068
-5	23	12221
0	32	9370
5	41	7240
10	50	5640
15	59	4427
20	68	3500
25	77	2786
30	86	2232
35	95	1800
40	104	1460
45	113	1191
50	122	977.1
55	131	806.2
60	140	668.7
65	149	557.6
70	158	467.2

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 243 Battery Temperature Sensor 3 Out of Range

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 245 Battery Temperature Sensor 4 High

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #4 is below -19°C (-2.2°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- View scan tool data.
- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 245 Battery Temperature Sensor 4 High

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 246 Battery Temperature Sensor 4 Low

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #4 is above 75°C (167°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 246 Battery Temperature Sensor 4 Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 247 Battery Temperature Sensor 4 Out of Range

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Temperature sensor #4 is reading 15°C (27°F) higher or lower the pack average temperature.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the MIL/DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	100544
-35	-31	72206
-30	-22	52426
-25	-13	38460
-20	-4	28491
-15	5	21302
-10	14	16068
-5	23	12221
0	32	9370
5	41	7240
10	50	5640
15	59	4427
20	68	3500
25	77	2786
30	86	2232
35	95	1800
40	104	1460
45	113	1191
50	122	977.1
55	131	806.2
60	140	668.7
65	149	557.6
70	158	467.2

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 247 Battery Temperature Sensor 4 Out of Range

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 249 Battery Temperature Sensor 5 High

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #5 is below -19°C (66.2°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 249 Battery Temperature Sensor 5 High

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 250 - Battery Temperature Sensor 5 Low

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #5 is above 75°C (167°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 250 Battery Temperature Sensor 5 Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 251 Battery Temperature Sensor 5 Out of Range

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Temperature sensor #5 is reading 15°C (27°F) higher or lower the pack average temperature.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the MIL/DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	100544
-35	-31	72206
-30	-22	52426
-25	-13	38460
-20	-4	28491
-15	5	21302
-10	14	16068
-5	23	12221
0	32	9370
5	41	7240
10	50	5640
15	59	4427
20	68	3500
25	77	2786
30	86	2232
35	95	1800
40	104	1460
45	113	1191
50	122	977.1
55	131	806.2
60	140	668.7
65	149	557.6
70	158	467.2

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 251 Battery Temperature Sensor 5 Out of Range

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 253 Battery Temperature Sensor 6 High

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #6 is below -19°C (-2°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 253 Battery Temperature Sensor 6 High

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 254 Battery Temperature Sensor 6 Low

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Battery Pack Control Module sensed temperature of sensor #6 is above 75°C (167°F).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 254 Battery Temperature Sensor 6 Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 255 Battery Temperature Sensor 6 Out of Range

Circuit Description

The Battery Pack Control Module monitors 6 temperature sensors within the battery pack assembly. Each of these temperature sensors is used to determine the overall pack temperature and the need for heating, cooling, SOC and charging of the battery modules. The Battery Pack Control Module also monitors each temperature sensor for an open, short or out of range condition. If one of the six sensors fail, the Battery Pack Control Module will use the other remaining five sensors to control the battery temperature. The system will operate normally until two or more sensors fail.

Conditions for Setting the DTC

- Temperature sensor 6 is reading 15°C (27°F) higher or lower the pack average temperature.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light only after one of the other five temperature sensors have set DTC(s).
- If two or more sensors are failed charging will be disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the MIL/DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The average temperature is used for SOC calculation.
- Maximum temperature is used for charging and cooling.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	100544
-35	-31	72206
-30	-22	52426
-25	-13	38460
-20	-4	28491
-15	5	21302
-10	14	16068
-5	23	12221
0	32	9370
5	41	7240
10	50	5640
15	59	4427
20	68	3500
25	77	2786
30	86	2232
35	95	1800
40	104	1460
45	113	1191
50	122	977.1
55	131	806.2
60	140	668.7
65	149	557.6
70	158	467.2

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

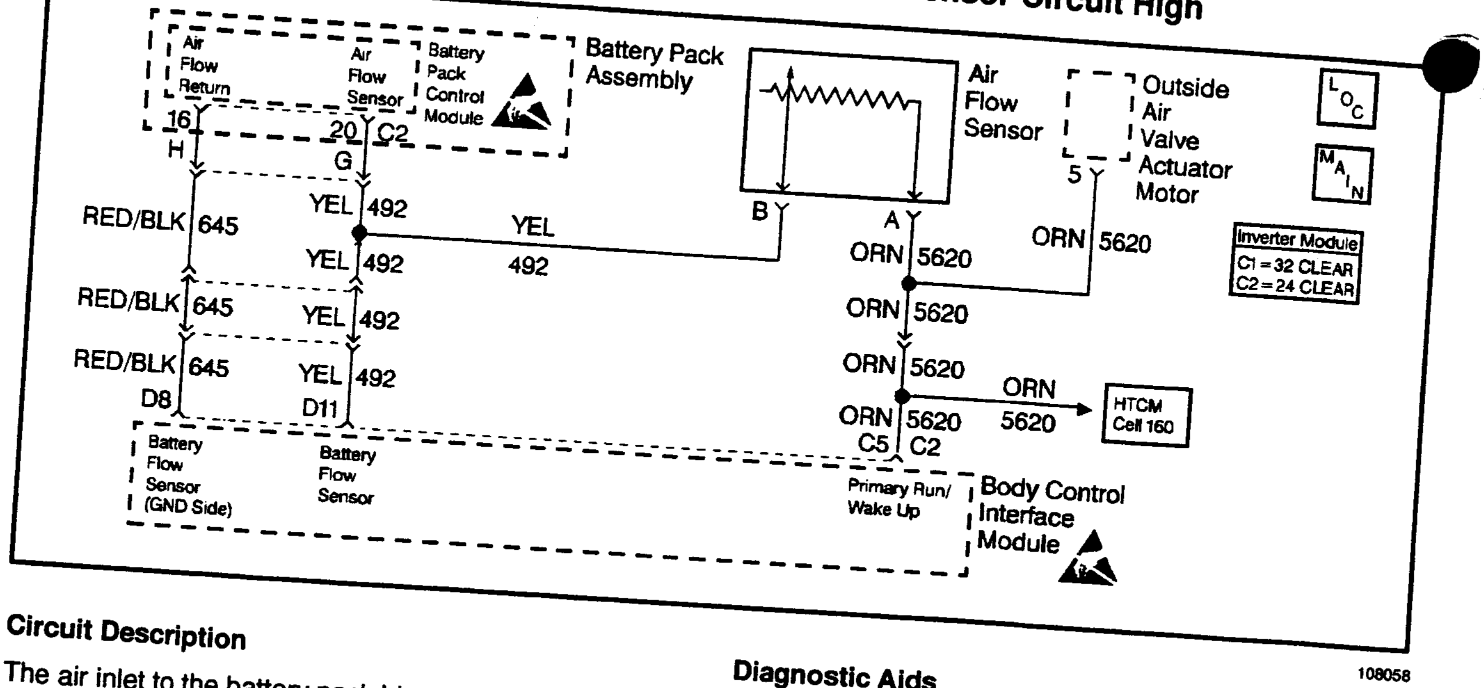
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 255 Battery Temperature Sensor 6 Out of Range

Step	Action	Value(s)	Yes	No
1	Was the "On-Board Diagnostic (OBD) System Check" performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 257 Battery Pack Blower Air Flow Sensor Circuit High


Air Flow Return
Air Flow Sensor
Battery Pack Control Module
Battery Pack Assembly
16
H
20
C2
G
RED/BLK 645
YEL 492
YEL 492
RED/BLK 645
YEL 492
RED/BLK 645
YEL 492
D8
D11
Battery Flow Sensor (GND Side)
Battery Flow Sensor
Air Flow Sensor
B
A
ORN 5620
ORN 5620
ORN 5620
ORN 5620
C5
C2
ORN 5620
HTCM Cell 160
Primary Run/ Wake Up
Body Control Interface Module
Outside Air Valve Actuator Motor
5
ORN 5620
LOC
MAIN
Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
108058

Circuit Description

The air inlet to the battery pack blower contains an air flow sensor which is self heating. When the battery pack blower is commanded on by the HTCM, air flow cools the sensor. The cooling of the sensor drops the voltage verifying that air is blowing into the battery pack.

Conditions for Setting the DTC

- Battery blower airflow sensor is above 100% as read by the Battery Pack Control Module.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Loss of power to the sensor will = 100% air flow.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks to see if the fault is present.
3. Checks for supply voltage to the sensor.
4. Checks for function of the entire circuit.
5. Checks for an open on circuit 492.
6. Checks for an open on circuit 645.

DTC 257 Battery Pack Blower Air Flow Sensor Circuit High

Step	Action	Value(s)	Yes	No
1	Was the On-Board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Using a scan tool record all current and history DTC(s). 2. Clear all DTC(s). 3. Cycle the vehicle OFF then ON. 4. Check For DTC(s). Did Battery Pack Control Module DTC 257 reset?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Remove the Battery Pack Blower Air Flow Sensor two wire connector. 2. With the key ON measure the voltage on terminal A of the Air Flow Sensor connector. Is the voltage at or greater than the specified value?	12 Volts	Go to Step 4	Go to Step 10
4	1. Using a fused jumper wire ground terminal B of the Air Flow Sensor connector. 2. Using a scan tool view the battery pack air flow sensor data. Does the scan tool display the specified value?	0 %	Go to Step 14	Go to Step 5
5	1. Install the 20 pin breakout box J 42494 at the 20-way battery pack connector. 2. Reconnect the air flow sensor. 3. Open the switch on pin G and H. 4. Measure the voltage on the harness side of pin G to ground. Is the voltage at the specified value?	12 Volts	Go to Step 6	Go to Step 13
6	1. Install the 20 pin breakout box J 42494 at the 20-way battery pack connector. 2. Reconnect the air flow sensor. 3. Open the switch on pin G and H. 4. Measure the voltage on the harness side of pin H to ground. Is the voltage at the specified value?	12 Volts	Go to Step 16	Go to Step 7
7	1. Disconnect the Body Control Interface Module 32-way connector. 2. Close switches G and H on the battery pack breakout box J 42494. 3. Turn the ignition ON. 4. Using a DMM measure the voltage on terminal D3 of the Body Control Interface Module 32-way harness. Is the voltage within the specified value?	12 Volts	Go to Step 8	Go to Step 12
8	1. Connect a test light to 12 volts. 2. Probe terminal D4 of the Body Control Interface Module 32-way connector. Did the test light turn ON?	—	Go to Step 15	Go to Step 9
9	1. Using the battery pack breakout box J 42494 open the switch for pin H. 2. Using a DMM check for an open on circuit 645 between the battery pack 20-way connector and the Body Control Interface Module. Was an open found?	—	Go to Step 11	Go to Step 16

DTC 257 Battery Pack Blower Air Flow Sensor Circuit High (continued)

Step	Action	Value(s)	Yes	No
10	Repair no voltage condition to the battery pack air flow sensor terminal A. Refer to *Electrical Diagnosis.* Is the action complete?	—	Go to Step 17	—
11	Repair the open in circuit 645 between the battery pack 20-way connector and the Body Control Interface Module. Refer to *Electrical Diagnosis.* Is the action complete?	—	Go to Step 17	—
12	Repair the open in circuit 492 to the Body Control Interface Module. Refer to *Electrical Diagnosis.* Is the action complete?	—	Go to Step 17	—
13	Repair the open in circuit 492 between the battery pack air flow sensor and the battery pack 20-way connector. Refer to *Electrical Diagnosis.* Is the action complete?	—	Go to Step 17	—
14	Replace the Battery Pack Blower Air Flow Sensor. Refer to *Battery Pack Blower Air Flow Sensor removal and replacement procedure.* Is the action complete?	—	Go to Step 17	—
15	Replace the Body Control Interface Module. Refer to Body Control Interface Module removal and replacement. Is the action complete?	—	Go to Step 17	—
16	Repair the Battery Pack. Refer to *battery pack internal service manual.* Is the action complete?	—	Go to Step 17	—
17	Clear DTC's. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 258 Battery Pack Blower Air Flow Sensor Circuit Low

Circuit Description

The battery pack contains an air flow sensor which is self heating. When the battery pack fan is commanded on by the Battery Pack Control Module, air flow cools the sensor. The cooling of the sensor drops the voltage verifying that air is flowing in the battery pack tunnel.

Conditions for Setting the DTC

- Battery pack blower airflow sensor is below 0% as read by the Battery Pack Control Module.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- This sensor is used by the Battery Pack Control Module to verify that air is flowing into the battery pack. The Battery Pack Control Module does not look for specific values from this sensor only the fact that the value changes when the battery pack blower is on.
- Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks to see if the fault is present.
3. Checks for an open air flow sensor.
4. Checks for a grounded circuit 492.

DTC 258 Battery Pack Blower Air Flow Sensor Circuit Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Using a scan tool record all current and history DTC(s). 2. Clear all DTC(s). 3. Cycle the ignition OFF then ON. 4. Check For DTC(s). Did Battery Pack Control Module DTC 258 reset?	—	Go to Step 3	Go to Diagnostic Aids
3	1. Disconnect the battery pack blower air flow sensor. 2. With a fused jumper wire, jumper terminals A and B at the air flow sensor connector. 3. Use a scan tool to view the battery pack air flow sensor data. Does the scan tool display the specified value?	100%	Go to Step 7	Go to Step 4
4	Connect a test light to 12 volts and probe terminal B of the battery pack air flow sensor harness. Did the test light turn ON?	—	Go to Step 5	Go to Step 10
5	With the test light ON remove the Body Control Interface Module 32-way connector. Did the test light turn OFF?	—	Go to Step 9	Go to Step 6
6	With the test light ON remove the battery pack 20-way connector. Did the test light turn OFF?	—	Go to Step 10	Go to Step 8

DTC 258 Battery Pack Blower Air Flow Sensor Circuit Low (continued)

Step	Action	Value(s)	Yes	No
7	Replace the battery pack blower air flow sensor. Refer to *HTCM section of the service manual.* Is the action complete?	—	Go to Step 11	—
8	Repair the short to ground on circuit 492. Refer to *Electrical Diagnosis.* Is the action complete?	—	Go to Step 11	—
9	Replace the Body Control Interface Module. Refer to Body Control Interface Module removal and replacement. Is the action complete?	—	Go to Step 11	—
10	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 11	—
11	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 265 Battery Air Inlet Temperature Sensor High

Circuit Description

The inlet air temperature sensor is located in the battery pack duct and monitors the temperature of the incoming air. If the incoming air is approximately the same temperature as the battery pack temperature, the Battery Pack Control Module will turn the drive motor battery blower motor off.

Conditions for Setting the DTC

- The battery pack air inlet temperature is below -19°C (-2°F) as read by the Battery Pack Control Module.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- View scan tool data.
- The Battery Pack Control Module will function normally with this DTC set. Service the Temp sensor only if other pack service is required.
- If Battery temperature sensors 1, 2, and air inlet all read Max value check for a sensor return problem after the splice.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 265 Battery Air Inlet Temperature Sensor High

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 266 Battery Air Inlet Temperature Sensor Low

Circuit Description

The inlet air temperature sensor is located in the battery pack and monitors the temperature of the incoming air. If the incoming air is approximately the same temperature as the battery pack temperature, the Battery Pack Control Module will turn the drive motor battery blower motor off.

Conditions for Setting the DTC

- The battery pack air temperature is above 65°C (149°F) as read by the Battery Pack Control Module.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- The Battery Pack Control Module will function normally with this DTC set. Service the Temp sensor only if other pack service is required.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. The System will function with one faulty sensor.

DTC 266 Battery Air Inlet Temperature Sensor Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is there more then one temperature sensor DTC set?	—	Go to Step 3	Go to Step 4
3	Is the DTC current?	—	Go to Step 5	Go to Diagnostic Aids
4	The system will function properly with one failed sensor. Disregard the DTC unless pack service is required for other DTC(s). Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 267 Battery Pack Blower Air Flow Sensor Performance

Circuit Description

When the Drive Motor Battery Control Module commands the fan on, air is forced into the battery assembly tunnel to cool and purge the tunnel of any gasses. The airflow sensor is a self heating sensor and as air flow cools the sensor the voltage changes verifying air flow is present.

Conditions for Setting the DTC

- Battery Pack Blower airflow sensor does not match battery pack fan speed commanded.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

This sensor is used by the Battery Pack Control Module to verify that air is flowing into the battery pack. The Battery Pack Control Module does not look for specific values from this sensor, only the fact that the value changes when the battery pack blower is on.

Check for the following conditions:

- A restriction in the air inlet may cause air flow to be reduced.
- Check the tightness of the female terminal grip with a spare male terminal.
- The Battery Pack Control Module commands only two speeds, 50% at startup and 100% (max. airflow) during charging and propulsion.
- The Battery Pack Control Module is looking for a change in the sensor voltage to indicate that it sees airflow.
- If the system seems to be operating properly it may be necessary to remove the battery pack and check for internal restrictions.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks to see if the DTC is current.
3. Checks for a restricted air intake.
4. Checks to insure that the battery pack fan is running.
5. Checks the air flow sensor circuit is able to pick up changes in fan speed.

DTC 267 Battery Pack Blower Air Flow Sensor Performance

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Using a scan tool record all current and history DTC(s). 2. Clear all DTC(s). 3. Cycle the ignition OFF then ON. 4. Check For DTC(s). Did Battery Pack Control Module DTC 267 reset?	—	Go to Step 3	Go to Diagnostic Aids
3	Perform a visual inspection of the battery pack blower air inlet tube checking for blockage, damage or disconnection. Was a problem found with the battery pack blower air inlet tube?	—	Go to Step 7	Go to Step 4
4	1. Using a scan tool command the battery pack blower ON at the highest speed. 2. Listen to the battery pack blower to verify if the blower is operating. Was the battery pack blower operating?	—	Go to Step 5	Go to Step 8
5	Using a scan tool command the battery pack blower on at HI and LO speeds while viewing the battery pack blower air flow sensor data parameter. Does the battery pack blower air flow sensor change with fan speed?	—	Go to Diagnostic Aids	Go to Step 6
6	Remove the battery pack blower air flow sensor connector. View the battery pack blower air flow sensor data on the scan tool. Does the scan tool read the specified value with the battery pack blower air flow sensor disconnected?	0%	Go to Step 9	Go to Step 10
7	Repair or replace the battery pack blower air inlet tube. Is the action complete?	—	Go to Step 11	—
8	The battery pack blower is inoperative. Refer to *HTCM section for diagnostic procedures.* Is the action complete?	—	Go to Step 11	—
9	Replace the battery pack blower air flow sensor. Refer to *battery pack blower air flow sensor removal and replacement.* Is the action complete?	—	Go to Step 11	—
10	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 11	—
11	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 268 Battery Pack Thermal Performance

Circuit Description

When the Drive Motor Battery Control Module commands the fan on, air is forced into the battery assembly tunnel to cool and purge the tunnel of any gasses. The airflow sensor is a self heating sensor and as air flow cools the sensor the voltage changes verifying air flow is present.

Conditions for Setting the DTC

- An airflow DTC is set when battery pack venting is required and 257, 258 or 267 are set.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light
- Regeneration and charging are disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- This DTC should never set without other airflow sensor DTC(s).
- Check the tightness of the female terminal grip with a spare male terminal.
- The Battery Pack Control Module commands only two speeds, 50% at startup and 100% (max. airflow) during charging and propulsion.
- The Battery Pack Control Module is looking for a change in the sensor voltage to indicate that it sees airflow.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This DTC will only set with other battery airflow sensor DTC(s).

DTC 268 Battery Pack Thermal Performance

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Refer to other airflow sensor DTC(s). Is the action complete?	—	Go to Step 3	Go to Diagnostic Aids
3	Clear DTC's. Refer To *Clearing Diagnostic Trouble Codes*. Is the action complete?	—	Go to OBD systems check	—

DTC 269 Battery Pack Over Temperature

Circuit Description

There are six temperature sensors that the Drive Motor Battery Control Module uses to determine the temperature of the Drive Motor Batteries. Maintaining battery temperature is important for battery life as well as battery efficiency.

Conditions for Setting the DTC

- Battery pack temperature is greater than 60°C (140°F).
- Vehicle is not charging.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- A restriction in the air inlet may cause poor battery cooling.
- Temperature sensors should read within 5°C of each other.
- This DTC is set based on the average of all valid battery temperature sensor readings.
- When the vehicle is in park, battery pack cooling will only occur if the true SOC is greater then 95%.
- When the vehicle is in drive, battery pack cooling will occur at any SOC.
- HTCM controls the cooling of the battery pack. Refer to *S-10 Electric service manual for HTCM diagnostics.*

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks for specific temperature sensor DTC(s).
4. Checks the actual temperature sensor value.

DTC 269 Battery Pack Over Temperature

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the DTC current?	—	Go to Step 3	Go to Diagnostic Aids
3	Are any other temperature DTC(s) set in any control modules?	—	Go to other DTC(s) first	Go to Step 4
4	Using a scan tool view battery module temperature sensors. Are all temperature sensors reading in the specified range?	60°C ± 5°C	Go to Step 5	Go to Step 6
5	Refer to HTCM section to diagnosis Battery Pack cooling fault. Is the action complete?	—	Go to Step 7	—
6	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 270 Battery Pack Over Temperature When Charging

Circuit Description

There are six temperature sensors located within the Battery Pack. The temperature sensors are used during charging to determine the temperature of the batteries within the Battery Pack. As the battery temperature increases during charging The HTCM provides cooling to prevent the batteries from overheating. If the HTCM can not cool the batteries sufficiently the Battery Pack Control Module will scale back the requested charge current to reduce the amount of heat being created.

Conditions for Setting the DTC

- Battery pack temperature is greater than 52°C (126°F).
- The vehicle is charging.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.
- Charging current is reduced.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Check for other temperature related DTC(s).
- Refer to HTCM section to insure A/C system is functioning properly.
- Perform a visual and physical inspection of the battery pack duct work looking for loose or damaged parts.
- Check charger output. If the charger is delivering excessive power the battery pack may overheat.
- Expect long charge times with this DTC.
- This DTC is set based on the highest valid battery temperature sensor reading.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks for specific temperature sensor DTC(s).
4. Checks the actual temperature sensor value.

DTC 270 Battery Pack Over Temperature When Charging

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the DTC current?	—	Go to Step 3	Go to Diagnostic Aids
3	Are any other temperature DTC(s) set in any control modules?	—	Go to other DTC(s) first	Go to Step 4
4	Using a scan tool view battery module temperature sensors. Are all temperature sensors reading in the specified range?	52°C ± 5°C	Go to Step 5	Go to Step 6
5	Refer to HTCM section to diagnose the Battery Pack cooling system. Is the action complete?	—	Go to Step 7	—
6	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual*. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes*. Is the action complete?	—	Go to OBD systems check	—

DTC 272 Automatic Disconnect Failed to Close

Circuit Description

When the auto disconnect is open and the vehicle is placed in the run mode, the auto disconnect controller will close the relays allowing high voltage to be supplied to the Power Inverter Module for propulsion. If the automatic disconnect attempts and fails to precharge the Power Inverter Module three times within five minutes the system will not allow another attempt for at least five minutes. This five minute rest period is designed to allow the precharge resisters time to cool and prevent vehicle damage.

Conditions for Setting the DTC

- Three or more auto disconnect closure attempts have failed within five minutes.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE NOW light.
- The WAIT light is illuminated.
- Propulsion is disabled.
- Disables the auto disconnect high voltage relays for five minutes.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 Power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Refer to other stored auto disconnect DTC(s).
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Refer to other auto disconnect DTC(s) to repair this problem.

DTC 272 Automatic Disconnect Failed to Close

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Refer to other Battery Pack Control Module auto disconnect DTC(s). Is the action complete?	—	Go to Step 3	Go to Diagnostic Aids
3	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 273 Automatic Disconnect Open

Circuit Description

When the vehicle is placed in the Run mode (with relays open) the Power Inverter Module capacitor precharge is initiated. The negative relay is closed and a low current relay in the auto disconnect is then closed allowing the capacitors to charge to 90% of the battery pack voltage. At this time the positive high voltage relay is closed and the low current relay is opened allowing for battery pack voltage to be supplied to the Power Inverter Module. This capacitor charging sequence is only performed if the high voltage relays have opened for some reason.

Conditions for Setting the DTC

- The automatic disconnect was unable to charge the high voltage bus within 10 seconds.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the SERVICE SOON light.
- The high voltage relays are open.
- The WAIT light is illuminated for 20 seconds.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 Power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The high voltage relays will chatter if there is an open between the battery pack and the Power Inverter Module.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks to see if the fault is current.
5. If DTC 272 is set a five minute timer must run out before precharge can be retried.
7. Checks to see if the problem is in the battery pack or on the vehicle.
8. Checks the charge receptacle for a short circuit.
9. Checks the High Voltage Disconnect Relays ground circuit.

DTC 273 Automatic Disconnect Open

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is Battery Pack Control Module DTC 273 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Are any other Drive Motor Control Module DTC(s) other than 070 set?	—	Refer to other DTC(s) first	Go to Step 4
4	Are any isolation DTC(s) set on any control modules?	—	Refer to other DTC(s) first	Go to Step 5
5	Is Battery Pack Control Module DTC 272 current?	—	Go to Step 6	Go to Step 7
6	Wait five minutes with the ignition OFF in order to clear DTC 272. Is the action complete?	—	Go to Step 7	—

DTC 273 Automatic Disconnect Open (continued)

Step	Action	Value(s)	Yes	No
7	1. Perform the high voltage disable procedure. 2. Disconnect the Power Inverter Module to battery pack jumper harness J 42493 at the Power Inverter Module. 3. Connect the Battery Pack Precharge/Discharge Tester J 42860 to the Power Inverter Module to battery pack jumper harness J 42493. 4. Enable the high voltage by reconnecting the High Voltage Disconnect and turning the ignition ON. Refer to the *High Voltage Enable Procedure.* Does the Battery Pack High Voltage system Power up and stay ON for the specified time?	5 minutes	Go to Step 8	Go to Step 9
8	1. Perform the High Voltage Disable Procedure. Refer to the *High Voltage Disable Procedure.* 2. Disconnect the Charge Receptacle cannon connector at the Power Inverter Module. 3. Using a DMM Check resistance at the Charge Receptacle Cannon connector between terminals A and C. The charge receptacle resistance should be infinite or open. Does the DMM indicate an open circuit?	—	Go to Step 12	Go to Step 13
9	1. Connect the Battery Pack Breakout Box J 42494 to the battery pack 20 way connector. 2. Open switches T and pin U. 3. Reconnect the high voltage disconnect connector. 4. Measure the resistance using a DMM between T and U on the harness side of the Battery Pack Breakout Box J 42494. Is the resistance greater than the specified value?	1 ohm	Go to Step 11	Go to Step 10
10	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 14	—
11	Repair open or short in wiring. Is the repair complete?	—	Go to Step 14	—
12	Replace the Charge Receptacle. Is the repair complete?	—	Go to Step 14	—
13	Replace the Power Inverter Module, Power steering control module and the Accessory Power Control Module. Refer to *Power Inverter Module replacement / reprogramming in this section.* Is the repair complete?	—	Go to Step 14	—
14	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 274 Automatic Disconnect Open Battery Pack Control Module Commanded

Circuit Description

The Battery Pack Control Module will command the auto disconnect to open the high voltage relays when it detects a fault condition requiring the vehicle to be shut down.

Conditions for Setting the DTC

- Fault must be present for 10 seconds.
- The battery pack Module has commanded the high voltage relays to open for any of the following reasons:
  - severe under voltage is detected.
  - severe over voltage is detected.
  - unintended charging detected.

Action Taken When the DTC Sets

- The Battery Pack Control Module will request the Drive Motor Control Module to turn on the SERVICE SOON lamp.
- The high voltage relays are open.
- The WAIT light is illuminated.
- DTC will be stored in failure records buffer.
- Propulsion will be disabled.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 Power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This DTC will set due to other Battery Pack Control Module sensed problems.

DTC 274 Automatic Disconnect Open Battery Pack Control Module Commanded

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Refer to other Battery Pack Control Module DTC(s). Is the action complete?	—	Go to Step 3	Go to Diagnostic Aids
3	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 275 Automatic Disconnect High Voltage Interlock Loop Circuit

Circuit Description

The interlock loop is a low voltage circuit that parallels the same path as the high voltage circuits. The auto disconnect applies a 7.9 - 10.6 voltage to the loop circuit to ensure continuity. The auto disconnect monitors this circuit for a voltage drop to ensure the integrity of all high voltage connections are maintained. The interlock loop, if functional , is between 3.2 and 7.3 volts.

Conditions for Setting the DTC

- The auto disconnect has detected an open or a voltage between 0 - 2.0 volts on the interlock loop for 10 seconds.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- The high voltage relays are open.
- The WAIT light is illuminated.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 Power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

4. Checks for an open in the charge receptacle.
6. Checks for an open in the drive motor.
12. This test determines if the PSCM is at fault.

DTC 275 Automatic Disconnect High Voltage Interlock Loop Circuit

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is Battery Pack Control Module DTC 275 current?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled*** Disable the high voltage. Refer to: *High Voltage Disable Procedure.* Is the action complete?	—	Go to Step 4	—
4	1. Disconnect the charge receptacle to the Power Inverter Module cannon connector. 2. Measure the resistance on the interlock pins E and D at the charge receptacle cannon connector harness. Is the resistance within the specified range?	0.1 - 0.7 ohms	Go to Step 5	Go to Step 17
5	Measure the resistance from pins E and D of the charge receptacle cannon connector to ground. Does the DMM indicate an open circuit?	—	Go to Step 6	Go to Step 17

DTC 275 Automatic Disconnect High Voltage Interlock Loop Circuit (continued)

Step	Action	Value(s)	Yes	No
6	1. Disconnect the drive motor to the Power Inverter Module cannon connector. 2. Measure the resistance on the interlock pins A and C at the drive motor cannon connector harness. Is the resistance within the specified range?	0.1 - 0.7 ohms	Go to Step 7	Go to Step 19
7	Measure the resistance from pins A and C of the drive motor cannon connector to ground. Does the DMM indicate an open circuit?	—	Go to Step 8	Go to Step 19
8	1. Jumper the interlock pins A and C on the Power Inverter Module side of drive motor cannon connector. 2. Jumper the interlock pins E and D on the Power Inverter Module side of charge receptacle cannon connector. 3. Remove the battery pack high voltage cable from the rear of the Power Inverter Module. 4. Using a DMM in the diode position measure the voltage drop between terminals C and D on the Power Inverter Module battery pack high voltage supply connector by placing the positive lead on terminal D and the negative lead on terminal C. Is the voltage drop greater then the specified values?	1.5 volts	Go to Step 9	Go to Step 10
9	1. With the interlock pins still jumpered use a DMM measure the resistance from pins C and D on the Power Inverter Module battery pack high voltage supply connector to ground. Does the DMM indicate an open circuit?	—	Go to Step 18	Go to Step 11
10	1. Remove the Power Inverter Module. 2. Remove the Accessory Power Control Module. 3. Jumper the interlock pins 1 and 5 on the Power Inverter Module side of the Accessory Power Control Module blind mate connector. 4. Insure that pins D and E on the charge port connector are still jumpered. 5. Insure that pins A and C on the drive motor connector are still jumpered. 6. measure resistance on the interlock pins C and D at the back of the Inverter Module. Is the resistance between the specified values?	0.1 - 0.7 ohms	Go to Step 15	Go to Step 12
11	1. Remove the Power Inverter Module. 2. Remove the Accessory Power Control Module. 3. Jumper the interlock pins 1 and 5 on the Power Inverter Module side of the Accessory Power Control Module blind mate connector. 4. Insure that pins D and E on the charge port connector are still jumpered. 5. Insure that pins A and C on the drive motor connector are still jumpered. 6. measure resistance from the interlock pins C and D at the back of the Inverter Module to the Power Inverter Module case. Does the DMM indicate an open circuit?	—	Go to Step 15	Go to Step 13

DTC 275 Automatic Disconnect High Voltage Interlock Loop Circuit (continued)

Step	Action	Value(s)	Yes	No
12	1. Remove the PSCM. 2. Jumper the interlock pins 4 and 9 on the Power Inverter Module side of the blind mate connector. 3. Insure that all other interlock pins are still jumpered. 4. measure the resistance on the interlock pins C and D at the back of the Power Inverter Module. Is the resistance between the specified values?	0.1 - 0.7 ohms	Go to Step 14	Go to Step 16
13	1. Remove the PSCM. 2. Jumper the interlock pins 4 and 9 on the Power Inverter Module side of the blind mate connector. 3. Insure that all other interlock pins are still jumpered. 4. measure the resistance from the interlock pins C and D at the back of the Power Inverter Module to the Power Inverter Module case. Does the DMM indicate an open circuit?	—	Go to Step 14	Go to Step 16
14	Inspect the PSCM to Power Inverter Module blind mate connector. If no trouble is found replace the PSCM. Refer to *PSCM removal and replacement procedure.* Is the action complete?	—	Go to Step 20	—
15	Inspect the Accessory Power Control Module to Power Inverter Module blind mate connector. If no trouble is found replace the Accessory Power Control Module. Refer to *Accessory Power Control Module removal and replacement procedure.* Is the action complete?	—	Go to Step 20	—
16	Replace the Power Inverter Module. Refer to *Power Inverter Module removal and installation.* Is the action complete?	—	Go to Step 20	—
17	Inspect the charge receptacle connector. If no trouble is found replace the charge receptacle. Refer to *Charge Receptacle removal and replacement procedure.* Is the action complete?	—	Go to Step 20	—
18	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 20	—
19	Replace the Drive Motor. Refer to *Drive Motor removal and installation.* Is the action complete?	—	Go to Step 20	—
20	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 276 Automatic Disconnect Precharge Circuit

Circuit Description

When the vehicle is placed in the Run mode (with relays open) the PIM capacitor precharge is initiated. The negative relay is closed and a low current relay in the auto disconnect is then closed allowing the capacitors to charge to 90% of the battery pack voltage. At this time the positive high voltage relay is closed and the low current relay is opened allowing for battery pack voltage to be supplied to the Power Inverter Module. This capacitor charging sequence is only performed if the high voltage relays have opened for some reason.

Conditions for Setting the DTC

- The automatic disconnect is in the precharge state for 10 seconds.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- The WAIT light is illuminated.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear from current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 Power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- This DTC may set if the battery pack high voltage cable is removed from the Power Inverter Module.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for other Battery Pack Control Module DTC(s) first.

DTC 276 Automatic Disconnect Precharge Circuit

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any other Battery Pack Control Module DTC(s) set?	—	Go to other DTC(s) first	Go to Step 3
3	Is DTC 276 current?	—	Go to Step 4	Go to Diagnostic Aids
4	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 277 Automatic Disconnect High Voltage Low

Circuit Description

The automatic disconnect is Powered by battery pack voltage. This voltage is stepped down to run the auto disconnect Power supply. This Power supply enables the auto disconnect to open and close the high voltage relays.

Conditions for Setting the DTC

- The automatic disconnect has detected a voltage below 182 volts from its Power supply for 10 seconds.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- The high voltage relays are open.
- The WAIT light is illuminated for 20 seconds.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 Power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- This DTC may set if the battery pack was driven to an extremely low voltage. Refer to malfunction history.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This step checks for other Battery Pack Control Module DTC(s) first.

DTC 277 Automatic Disconnect High Voltage Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any other Battery Pack Control Module DTC(s) set?	—	Go to other DTC(s) first	Go to Step 3
3	Is DTC 277 current?	—	Go to Step 4	Go to Diagnostic Aids
4	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 278 Automatic Disconnect Ground Circuit

Circuit Description

The auto disconnect receives a vehicle ground references to use for isolation detection. The auto disconnect monitors this ground reference for an open condition. The ground sense lead wire used by the auto disconnect runs through the high voltage disconnect under the hood, therefore when the high voltage disconnect connector is removed the auto disconnect looses it's relationship to ground and opens the high voltage relays.

Conditions for Setting the DTC

- The automatic disconnect has detected a loss of ground for 10 seconds.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- The high voltage relays are opened.
- The WAIT light is illuminated.
- Propulsion and charging are disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after the fault is no longer present.
- The DTC will clear from history after 100 Power cycles.

Diagnostic Aids

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.
- The auto disconnect ground source goes through the High Voltage Disconnect connector to the right front frame rail.
- If the High Voltage Disconnect is removed with the key ON Battery Pack Control Module DTC 278 and Drive Motor Control Module DTC 070 will be set.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks if the high voltage disconnect has been removed.
4. Checks ground reference on CKT 931.

DTC 278 Automatic Disconnect Ground Circuit

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is DTC 278 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Has the high voltage disconnect been removed?	—	Go to Step 5	Go to Step 4
4	1. Connect the battery pack breakout box J 42494 to the battery pack 20 way connector. 2. Install the High Voltage Disconnect Connector. 3. Open pin V. 4. Measure the resistance between pin V on the harness side of the battery pack breakout box J 42494 and the negative terminal on the auxiliary battery. Is the resistance greater than the specified value?	1 ohm	Go to Step 6	Go to Step 7
5	Disregard DTC 278. Is the action complete?	—	Go to Step 8	—
6	Repair open or high resistance on ground sense circuit. Is the action complete?	—	Go to Step 8	—
7	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 8	—
8	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 279 Automatic Disconnect High Voltage Isolation

Circuit Description

The automatic disconnect monitors the positive and negative high voltage leads with reference to chassis ground. The high voltage system should be isolated from chassis ground with at least 600k ohms. If the auto disconnect detects an imbalance on the high voltage positive or negative bus it will set a fault and open the high voltage relays.

Conditions for Setting the DTC

- The automatic disconnect has detected a high voltage isolation fault for 10 seconds.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- The WAIT light is illuminated.
- Propulsion and charging are disabled.
- DTC will be stored in failure records buffer.
- The high voltage relays open based on the following:
  - Vehicle speed is below 1 km/h for 180 seconds.

or

  - The vehicle is placed in park for 10 seconds

or

When current exceeds for 2 seconds:

Vehicle Speed	Current (Amps)
0 mph	-100
8 mph	-200
16 mph	-300
24 mph	-400
32-70 mph	-440

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after the fault is no longer present.
- The DTC will clear from history after 100 Power cycles.

Diagnostic Aids

- Refer to HTCM Diagnosis to check the Air Conditioning compressor for High Voltage Isolation.
- Check for pinched or damaged High Voltage cables or connections.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks if the DTC is current.
4. This step determines if the problem is in the Power Inverter Module or the Battery Pack.
5. This step checks the Charge Receptacle.
6. This step checks the Drive Motor.
8. This step checks the Accessory Power Control Module.
9. This step checks the Power Steering Control Module.

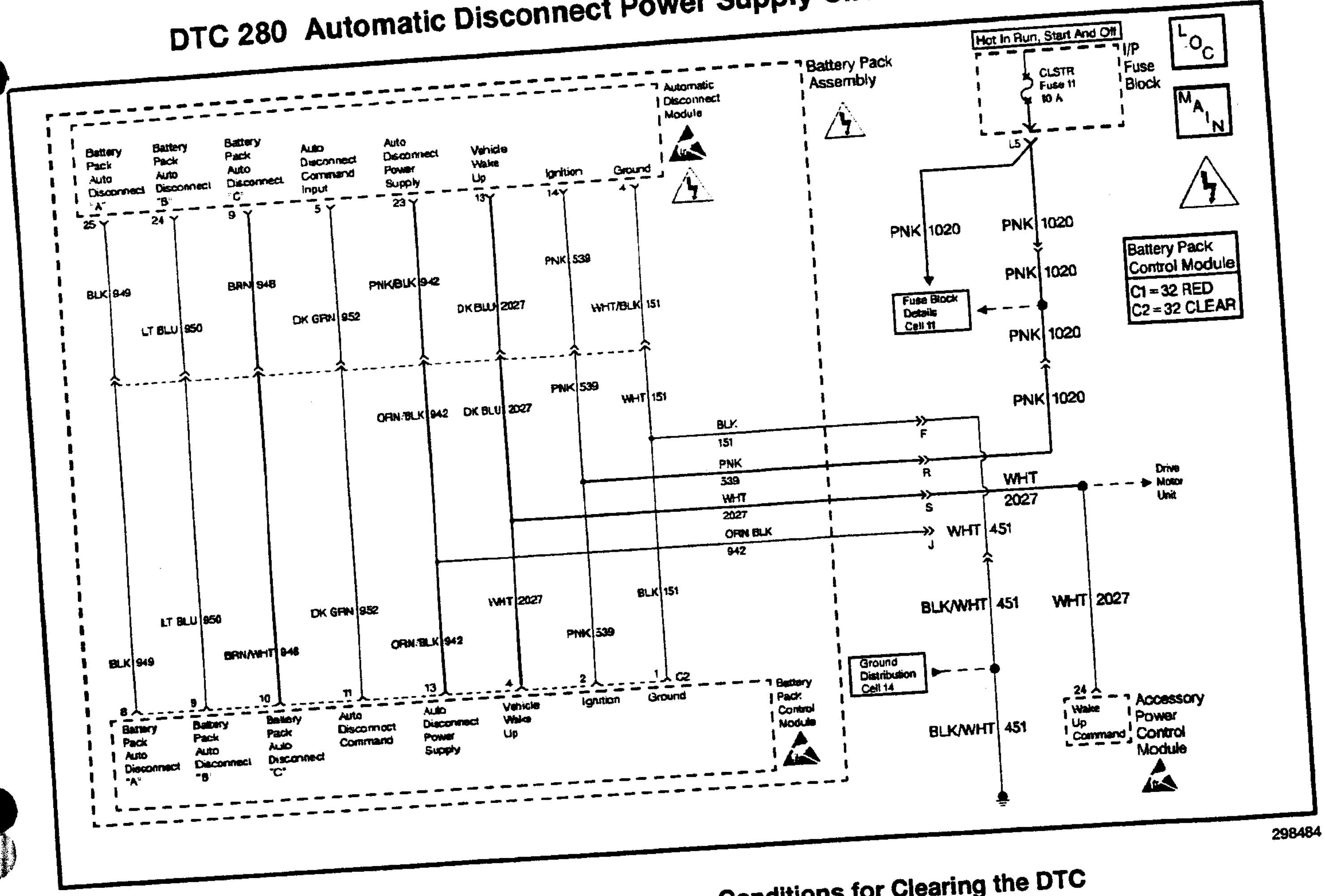
DTC 279 Automatic Disconnect High Voltage Isolation

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is DTC 279 current?	—	Go to Step 3	Go to Diagnostic Aids
3	***Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled.*** Perform the High Voltage Disable Procedure. Is the action complete?	—	Go to Step 4	—
4	1. Disconnect the Battery Pack cannon connector at the Power Inverter Module. 2. Connect the Battery Pack to Power Inverter Module Extension J 42493 to the Battery Pack cannon connector. 3. Connect the Battery Pack Precharge/Discharge Tester J 42860 to the Battery Pack to Power Inverter Module Extension J 42493. 4. Enable the high voltage by reconnecting the High Voltage Disconnect. Refer to the *High Voltage Enable Procedure.* Does the Battery Pack High Voltage system Power up and stay on longer than the specified time value?	5 minutes	Go to Step 5	Go to Step 10
5	1. Disconnect the charge receptacle cannon connector from the front of the Power Inverter Module. 2. Using the digital insulation tester J 42502 on the 500V setting measure the isolation from chassis ground to the positive pin A and negative pin C of the charge receptacle cannon connector. Is isolation equal to or greater than the specified value?	1.6M ohms	Go to Step 6	Go to Step 14
6	1. Remove the Power Inverter Module to drive motor cannon connector at the Power Inverter Module. 2. Using the Digital Insulation Tester J 42502, Clip the black lead to the drive motor housing. 3. Switch the Insulation tester J 42502 to the 1000 volts position. 4. Check each phase for an short condition buy turning the tester ON and probing each pin on the drive motor cannon connector one at a time. Did each drive motor winding phase read equal to or greater than the specified resistance?	5M ohms	Go to Step 7	Go to Step 11
7	Check the A/C compressor for an isolation fault. Refer to *HTCM section.* Was a fault found?	—	Go to Step 17	Go to Step 8

DTC 279 Automatic Disconnect High Voltage Isolation (continued)

Step	Action	Value(s)	Yes	No
8	1. Remove the Power Inverter Module from the vehicle. Refer to *Power Inverter Module removal procedure.* 2. Remove the Accessory Power Control Module. Refer to *Power Inverter Module removal procedure.* 3. Using the digital insulation tester J 42502 on the 500V setting measure the isolation from the Accessory Power Control Module case to the positive pin A1 and negative pin A2 of the Accessory Power Control Module blind mate connector. Is isolation at equal to or greater than the specified value?	1.6M ohms	Go to Step 9	Go to Step 13
9	1. Remove the Power Steering Control Module. Refer to *Power Inverter Module removal procedure.* 2. Using the digital insulation tester J 42502 on the 500V setting measure the isolation from the Power Steering Control Module case to the positive pin 8 and negative pin 5 of the Power Steering Control Module blind mate connector. Is isolation at equal to or greater than the specified value?	1.6M ohms	Go to Step 15	Go to Step 13
10	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 18	—
11	Replace the drive motor. Refer to *Drive Motor removal and replacement.* Is the action complete?	—	Go to Step 18	—
12	Replace the Power Steering Control Module. Refer to *Power Steering Control Module removal and replacement.* Is the action complete?	—	Go to Step 18	—
13	Replace the Accessory Power Control Module. Refer to *Accessory Power Control Module removal and replacement.* Is the action complete?	—	Go to Step 18	—
14	Replace the charge receptacle. Refer to *Charge receptacle removal and replacement.* Is the action complete?	—	Go to Step 18	—
15	Replace the Power Inverter Module. Refer to *Power Inverter Module removal and replacement procedure.* Is the action complete?	—	Go to Step 18	—
16	Replace the Automatic Disconnect Module. Refer to *Automatic Disconnect Module* Removal and Installation. Is the action complete?	—	Go to Step 18	—
17	Replace the A/C compressor. Is the action complete?	—	Go to Step 18	—
18	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 280 Automatic Disconnect Power Supply Circuit Out of Range


Hot In Run, Start And Off
CLSTR Fuse 11 10 A
I/P Fuse Block
Battery Pack Assembly
Automatic Disconnect Module
Battery Pack Auto Disconnect "A"
Battery Pack Auto Disconnect "B"
Battery Pack Auto Disconnect "C"
Auto Disconnect Command Input
Auto Disconnect Power Supply
Vehicle Wake Up
Ignition
Ground
25
24
9
5
23
13
14
4
L5
BLK 949
LT BLU 950
BRN 948
DK GRN 952
PNK/BLK 942
DK BLU 2027
PNK 539
WHT/BLK 151
PNK 1020
Fuse Block Details Cell 11
Battery Pack Control Module
C1 = 32 RED
C2 = 32 CLEAR
ORN/BLK 942
WHT 151
BLK 151
PNK 339
WHT 2027
ORN BLK 942
F
R
S
J
WHT 2027
Drive Motor Unit
WHT 451
BLK/WHT 451
WHT 2027
BRN/WHT 948
Ground Distribution Cell 14
8
9
10
11
13
4
2
1
C2
Battery Pack Control Module
Battery Pack Auto Disconnect "A"
Battery Pack Auto Disconnect "B"
Battery Pack Auto Disconnect "C"
Auto Disconnect Command
Auto Disconnect Power Supply
Vehicle Wake Up
Ignition
Ground
24
Wake Up Command
Accessory Power Control Module
298484

Circuit Description

The automatic disconnect is Powered by battery pack voltage. This voltage is stepped down to run the auto disconnect Power supply. This Power supply enables the auto disconnect to open and close the high voltage relays.

Conditions for Setting the DTC

- The battery pack has detected a automatic disconnect voltage less than 9.5 volts for 10 seconds.

or

- The battery pack has detected a automatic disconnect voltage greater than 15.5 volts for 10 seconds.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- The WAIT light is illuminated.
- Propulsion is disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 Power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- If the high voltage disconnect has been pulled this DTC may set. If this is the case clear the DTC and see if the code resets under normal operation.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

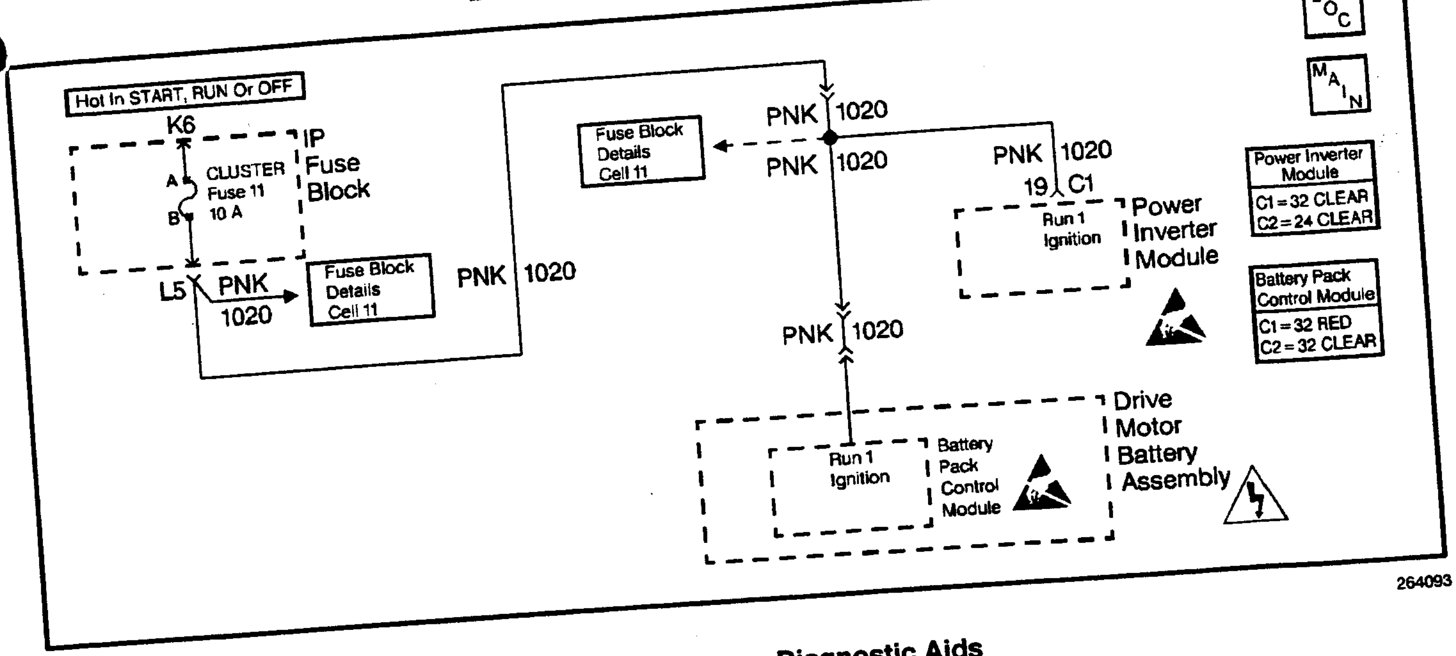
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks if the DTC is current.

DTC 280 Automatic Disconnect Power Supply Circuit Out of Range

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is DTC 280 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 281 Run 1 Voltage Circuit


Hot In START, RUN Or OFF
K6
CLUSTER
Fuse 11
10 A
A
B
IP
Fuse
Block
L5
PNK
1020
Fuse Block
Details
Cell 11
PNK 1020
Fuse Block
Details
Cell 11
PNK 1020
PNK 1020
PNK 1020
19 C1
Run 1
Ignition
Power
Inverter
Module
PNK 1020
Run 1
Ignition
Battery
Pack
Control
Module
Drive
Motor
Battery
Assembly
LOC
MAIN
Power Inverter
Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Battery Pack
Control Module
C1 = 32 RED
C2 = 32 CLEAR
264093

Circuit Description

When the vehicle is Powered on the ignition switch will supply run 1 Power to the Battery Pack Control Module . The Battery Pack Control Module will wake up when it receives the run 1 (12 volt) signal.

Conditions for Setting the DTC

- The battery pack control Module sees no voltage on the run 1 circuit.
- Data is being received form the Drive Motor Control Module for 1 minute.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 Power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

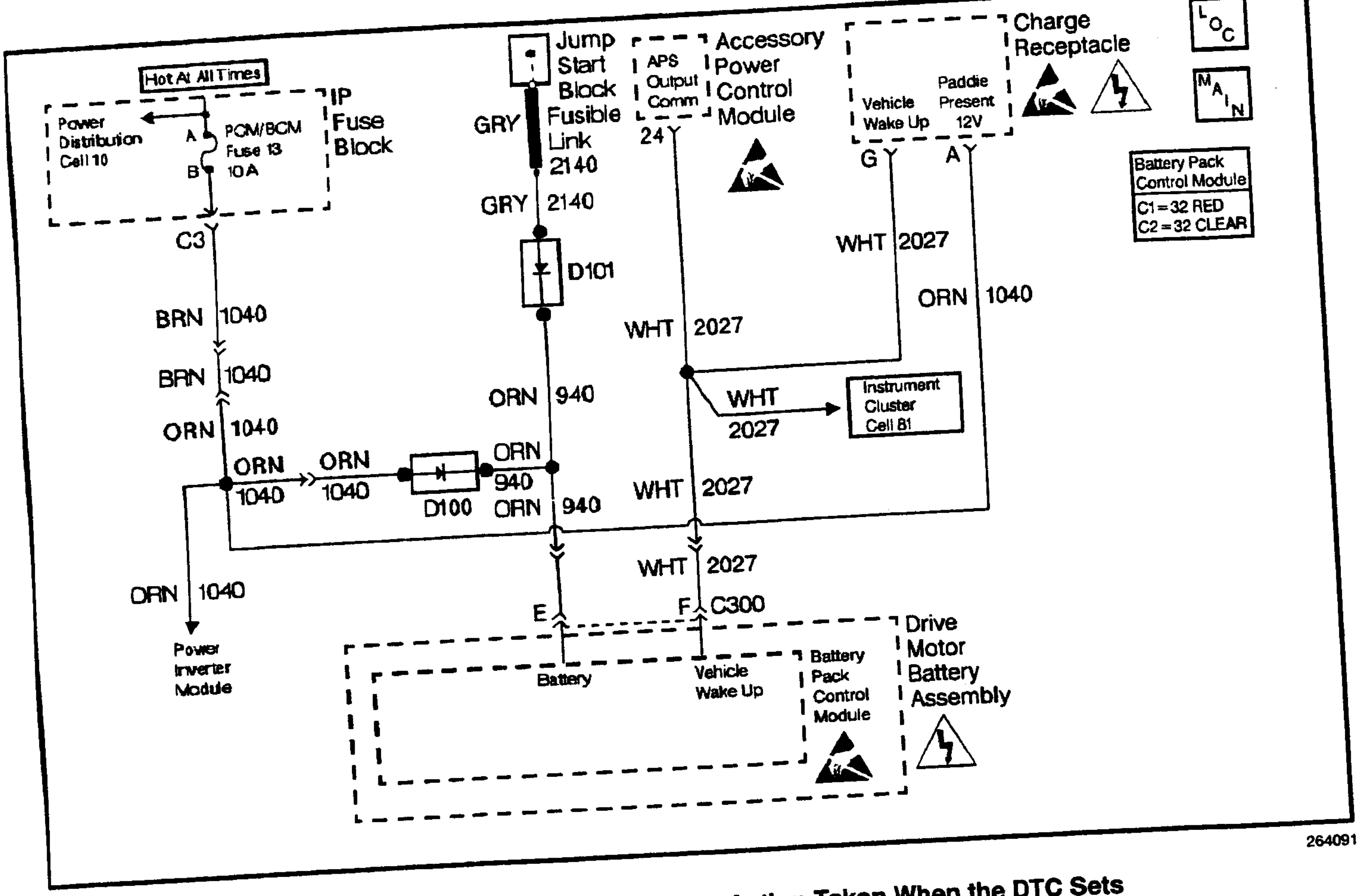
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks for other low auxiliary Power DTC(s) first.
4. Checks the voltage supply to the Battery Pack 20–way connector.

DTC 281 Run 1 Voltage Circuit

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault present?	—	Go to Step 3	Go to Diagnostic Aids
3	Are any other low auxiliary Power DTC(s) set?	—	Go to Other DTC(s) first	Go to Step 4
4	***Notice:*** Performing the following procedures will result in one or more Battery Pack Control Module DTC(s) being set. 1. Connect the battery pack breakout box J 42494 to the 20-way in-line battery pack connector. 2. Open the pin R switch on J42494. 3. Turn the ignition ON. 4. Measure the voltage on pin R to ground on the harness side. Is the voltage above the specified value?	11.5 volts	Go to Step 6	Go to Step 5
5	Repair open or low voltage condition from switched ignition on CKT 1020. Is the action complete?	—	Go to Step 7	—
6	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 282 Vehicle Wake Up Circuit


Hot At All Times
Power Distribution Cell 10
A
B
PCM/BCM Fuse 13 10A
IP Fuse Block
C3
BRN 1040
BRN 1040
ORN 1040
ORN 1040
ORN 1040
ORN 1040
ORN 1040
Power Inverter Module
Jump Start Block Fusible Link 2140
GRY
GRY 2140
D101
ORN 940
ORN 940
D100
ORN 940
APS Output Comm
24
Accessory Power Control Module
WHT 2027
WHT 2027
WHT 2027
Instrument Cluster Cell 81
WHT 2027
WHT 2027
Vehicle Wake Up
Paddle Present 12V
G
A
Charge Receptacle
ORN 1040
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
E
F
C300
Battery
Vehicle Wake Up
Battery Pack Control Module
Drive Motor Battery Assembly
264091

Circuit Description

When the ignition is OFF and the charge paddle is inserted or periodic wake-up is requested from the HTCM a 12 volt signal is momentarily sent to the Battery Pack Control Module on the wake-up circuit. After the Battery Pack Control Module senses that a 12 volt spike has been sent from the charge receptacle or the HTCM the Battery Pack Control Module begins supplying 12 volts continuously to the wake-up line. During the time that the Battery Pack Control Module is supplying 12 volts to the wake-up line the Aux. Battery should remain fully charged and the HTCM should be communicating on the UART line.

Conditions for Setting the DTC

- Ignition OFF.
- No auto disconnect DTC(s) 273 - 280.
- Vehicle wake up is commanded.
- Auxiliary battery voltage is less than 12 volts for 60 seconds.

OR

- HTCM is not communicating on the data bus for 60 seconds.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 Power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- If the vehicle will not charge with the key off without cradling the charge paddle in the charger first check for an open on circuit 2027 between the charge receptacle and the splice.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks for DTC 300 or DTC 311 first.
4. Checks for wake up voltage to the Battery Pack.
5. Checks for Accessory Power Control Module power.

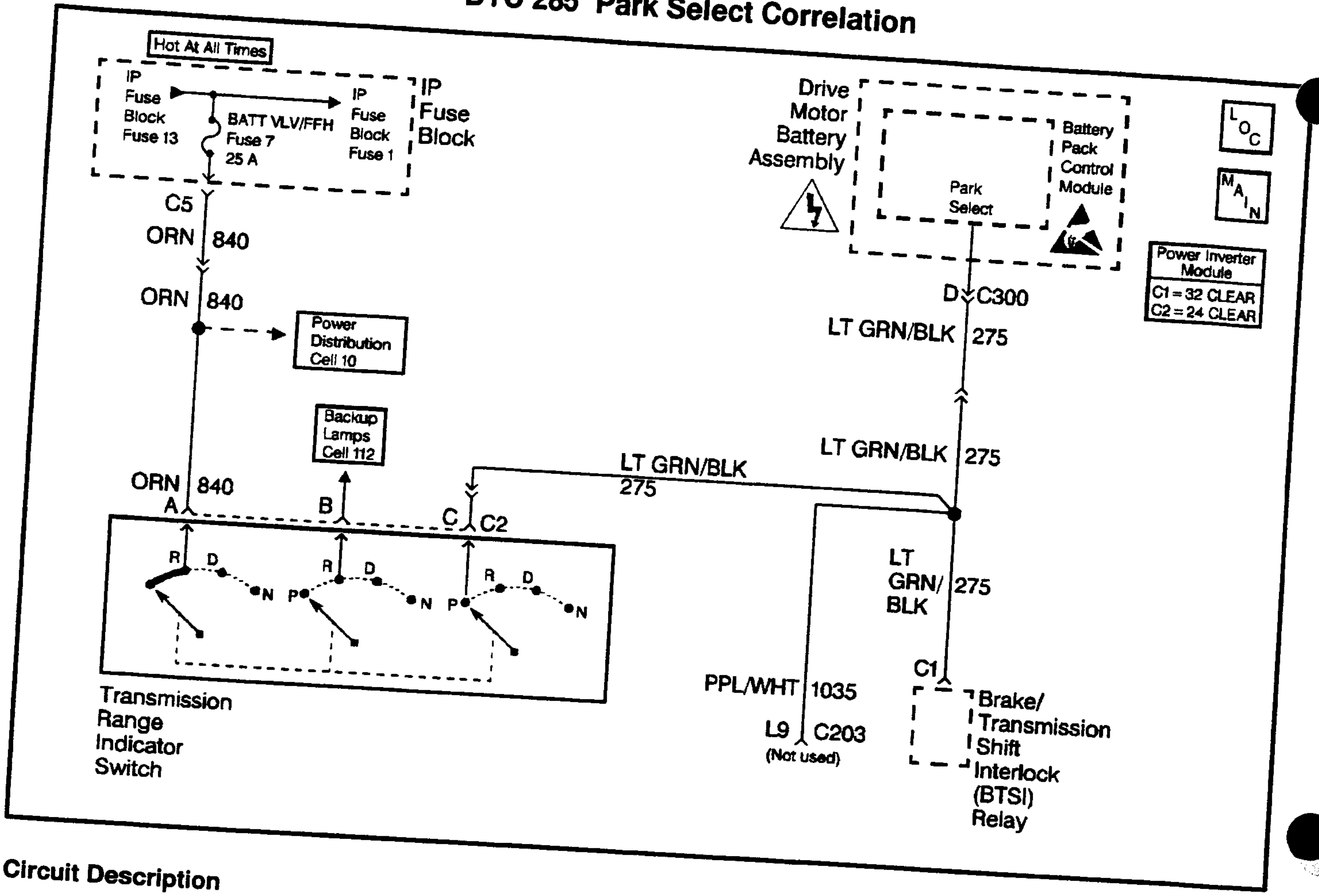
DTC 282 Vehicle Wake Up Circuit

Step	Action	Value(s)	Yes	No
1	Was the On board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the ignition OFF. 2. Insert the charge paddle into the charge receptacle and insure that the vehicle is charging. 3. Wait the specified time and check if the DTC reset. Did the DTC reset ?	2 minutes	Go to Step 3	Go to Diagnostic Aids
3	Is Battery Pack Control Module DTC(s) 300 or 311 also set?	—	Go to Other DTC(s) first	Go to Step 4
4	***Notice:*** Performing the following procedures will result in one or more Battery Pack Control Module DTC(s) being set. 1. Turn the ignition OFF. 2. Disconnect the 20-way battery pack connector and install the Battery Pack Breakout Box J 42494. 3. Insert the charge paddle and insure that the vehicle is charging. 4. Wait 60 seconds and measure the voltage on pin S of J 42494. Was the voltage above the specified value on pin S?	12 volts	Go to Step 5	Go to Step 8
5	With the ignition OFF and the vehicle charging measure the voltage at the Aux. Battery with a DMM. Is the Aux. Battery voltage below the specified value?	13 volts	Go to Step 6	Go to Step 7
6	***Notice:*** The following procedure will set DTC(s) in the HTCM. When this step has been completed clear DTC(s) and continue. 1. With the ignition OFF and the vehicle charging remove the Accessory Power Control Module 24-way connector. 2. Using a DMM check for voltage at terminal 24 of the Accessory Power Control Module 24-way connector. Is the voltage at or above the specified value?	10 volts	Go to Step 12	Go to Step 10
7	***Notice:*** The following procedure will set DTC(s) in the HTCM. When this step has been completed clear DTC(s) and continue. 1. With the ignition OFF and the vehicle charging remove the HTCM 32-way connector. 2. Using a DMM check for voltage at terminal D15 of the HTCM 32-way connector. Is the voltage at or above the specified value?	10 volts	Go to Step 11	Go to Step 9

DTC 282 Vehicle Wake Up Circuit (continued)

Step	Action	Value(s)	Yes	No
8	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 13	—
9	Repair no voltage condition on CKT. 2027 to the HTCM. Refer to *Wiring repair* in Electrical Diagnosis. Is the repair complete?	—	Go to Step 13	—
10	Repair no voltage condition on CKT. 2027 to the Accessory Power Control Module. Refer to *Wiring repair* in Electrical Diagnosis. Is the repair complete?	—	Go to Step 13	—
11	Replace the HTCM. Refer to *HTCM section.* Is the action complete?	—	Go to Step 13	—
12	Replace the Accessory Power Control Module. Refer to *Accessory Power Control Module removal and replacement.* Is the repair complete?	—	Go to Step 13	—
13	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 285 Park Select Correlation



Hot At All Times
IP Fuse Block Fuse 13
BATT VLV/FFH Fuse 7 25 A
IP Fuse Block Fuse 1
IP Fuse Block
C5
ORN 840
ORN 840
Power Distribution Cell 10
Backup Lamps Cell 112
ORN 840
A
B
C
C2
R D N P
Transmission Range Indicator Switch
Drive Motor Battery Assembly
Battery Pack Control Module
Park Select
D C300
LT GRN/BLK 275
LT GRN/BLK 275
LT GRN/BLK 275
LT GRN/BLK 275
PPL/WHT 1035
L9 C203
(Not used)
C1
Brake/ Transmission Shift Interlock (BTSI) Relay
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
264098

Circuit Description

The Drive Motor Control Module and the Battery Pack Control Module each monitor the state of the Transmission Range Indicator Switch position through there own discrete inputs. The two control modules then compare there findings over serial data. In the event that one control module sees a different Park state then the other, a DTC will be set.

Conditions for Setting the DTC

- Ignition ON.
- Run 2 power supplied.
- The Drive Motor Control Module has a defined state for the Transmission Range Switch.
- The Battery Pack Control Module and the Drive Motor Control Module do not agree on park status for 10 seconds.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Charging is disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- If back-up lamps are also inoperative check for blown fuses or no power to the Transmission Range Indicator Switch 3-way connector pin A.
- Move the shift lever while in Park and see if Battery Pack Control Module Transmission Range Indicator Switch changes state. The Transmission Range Indicator Switch may be out of adjustment.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks to see if the fault is present.
3. DTC 061 will fix most Transmission Range Switch problems.
5. Checks to see if the TR switch is out of adjustment.
6. Checks for a voltage on circuit 275 from the TR switch.
7. Checks for contunuity between the TR switch and the Battery Pack 20-way.
8. Checks the TR switch for proper operation.

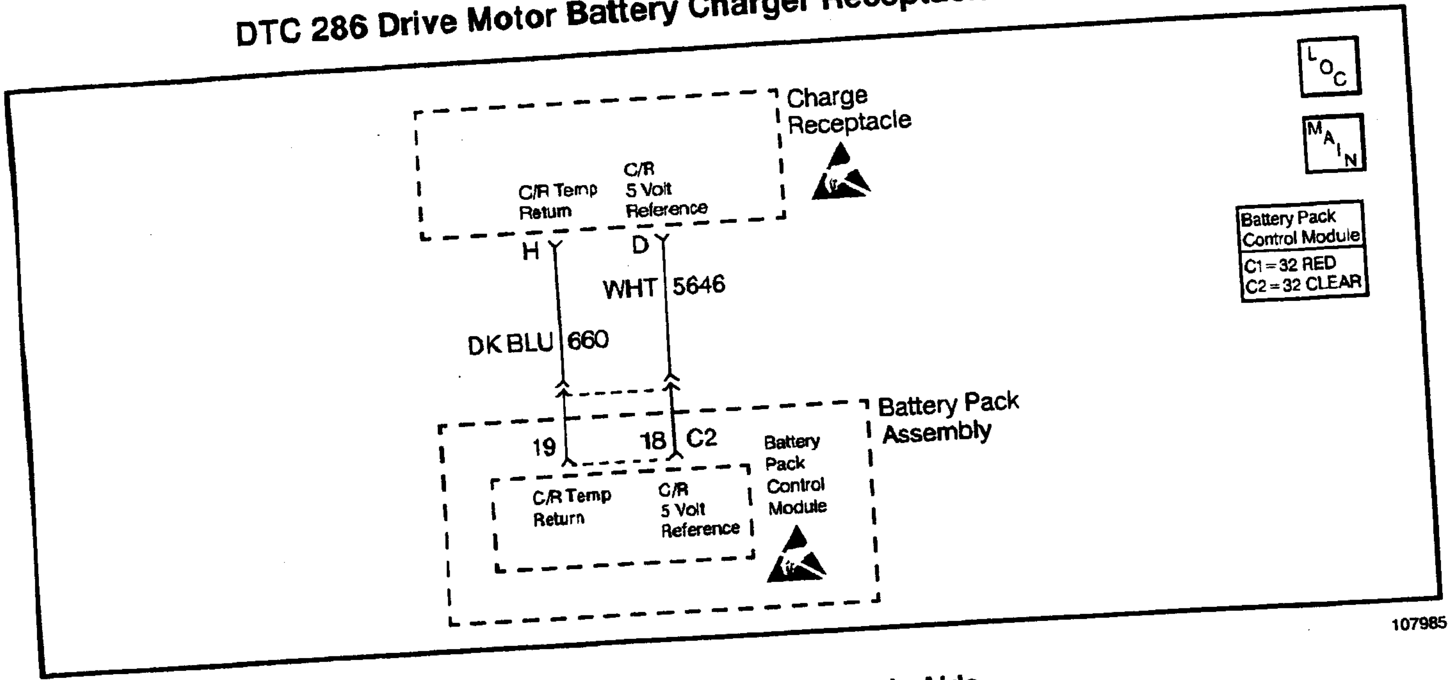
DTC 285 Park Select Correlation

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the DTC current?	—	Go to Step 3	Go to Diagnostic Aids
3	Is Drive Motor Control Module DTC 061 also set?	—	Go to other DTC first	Go to Step 4
4	1. Turn the ignition to run. 2. Place the shift lever in park. 3. Using a scan tool view the Battery Pack Control Module Park Selected. Does the scan tool show YES?	YES	Go to Step 5	Go to Step 6
5	Wiggle the shift lever Did the park status change?	—	Go to Step 13	Go to Step 6
6	1. Connect the 20-way battery pack breakout box J 42494 to the vehicle in-line connector. 2. Turn the key ON. 3. Insure the vehicle is in park. 4. Do not engage the brake switch. 5. Measure the voltage on pin D to ground. Is the voltage above the specified value?	12 volts	Go to Step 10	Go to Step 7
7	1. Turn the igniton Off. 2. Disconnect the 3- way connector from the Transmission Range Indicator Switch. 3. Check for continuity on the harness side of the T/R Switch 3-way connector terminal C to terminal D of the battery pack breakout box J 42494. Is continuity present?	—	Go to Step 8	Go to Step 14
8	Measure the resistance between pins A and C on the switch side of the Transmission Range Indicator 3-way connector with the vehicle in park. Is the resistance above the specified value?	1 ohm	Go to Step 12	Go to Step 9
9	1. Turn the ignition ON. 2. Ensure the vehicle shifter is in park. 3. Measure the voltage on pin A of the 3-way harness. Is the voltage at or above the specified value?	12 volts	Go to Step 12	Go to Step 11
10	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 15	—

DTC 285 Park Select Correlation (continued)

Step	Action	Value(s)	Yes	No
11	Repair no voltage condition on circuit 840 to pin A. Is the action complete?	—	Go to Step 15	—
12	Replace the Transmission Range Indicator Switch. Is the action Complete?	—	Go to Step 15	—
13	Adjust the shift lever and cable. Is the action complete?	—	Go to Step 15	—
14	Repair the wire between the Transmission Range Switch 3 way connector terminal 2 and terminal D of the 20 way connector. Is the action complete?	—	Go to Step 15	—
15	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 286 Drive Motor Battery Charger Receptacle Circuit Low


Charge Receptacle
C/R Temp Return
C/R 5 Volt Reference
H
D
WHT 5646
DK BLU 660
Battery Pack Assembly
19
18 C2
Battery Pack Control Module
C/R Temp Return
C/R 5 Volt Reference
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR

107985

Circuit Description

Located in the charge receptacle is the temperature sensor which has two functions. When the charge paddle is inserted it completes the path that enables the Battery Pack Control Module to read the temperature of the charge receptacle. If the Battery Pack Control Module can read the temperature it also indicates that the charge paddle is present in the charge receptacle. When the charge paddle is not inserted the Battery Pack Control Module should read a temperature of 0°C (32°F).

Conditions for Setting the DTC

- The charge paddle is inserted into the charge receptacle.
- Temperature sensor resistance measured by the Battery Pack Control Module is below 300 ohms (100°C).

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Charging is disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Check the coolant flow valve to the charge receptacle for proper operation.
- Check for Battery Pack Control Module DTC 288.
- Charge the vehicle until the temperature stabilizes. The sensor may only fail when hot.

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	336,500
-30	-22	177,000
-20	-4	97,070
-10	14	55,330
0	32	32,650
10	50	19,900
20	68	12,490
30	86	8,057
40	104	5,327
50	122	3,603
60	140	2,488
70	158	1,752
80	176	1,258
90	194	917.7
100	212	680
110	230	511.2
120	248	389.3
130	266	300.9
140	284	234.8
150	302	185.3

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

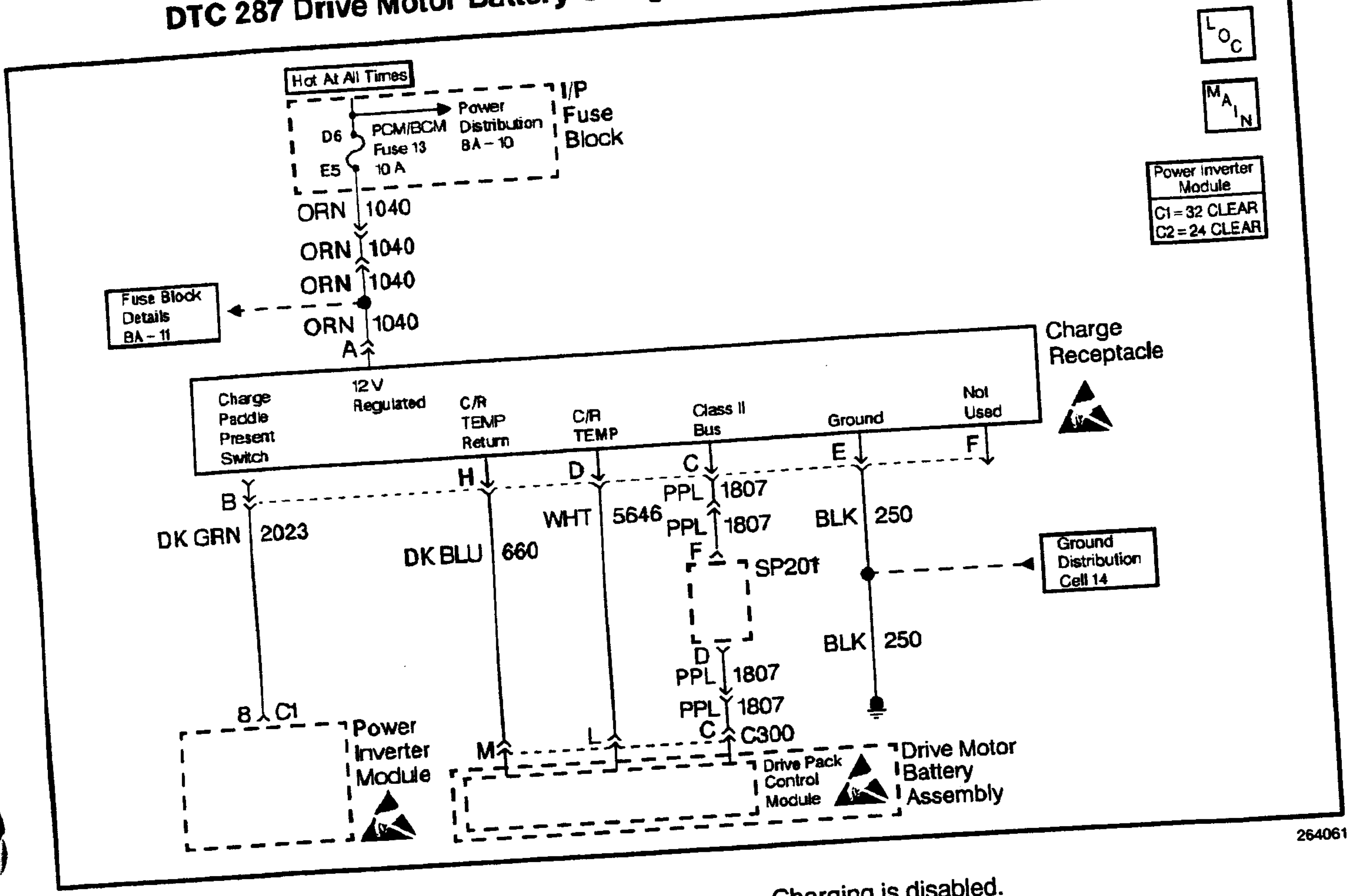
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks to see if the DTC is current.
4. Checks to see if the fault is in the charge receptacle.
5. Checks the temp sensor circuit from the 20-way connector.

DTC 286 Drive Motor Battery Charger Receptacle Circuit Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Install the charge paddle in the charge receptacle. 2. Using a scan tool view Battery Pack Control Module DTC(s). Is DTC 286 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Using a scan tool view charge receptacle temperature. Is charge receptacle temperature read at or above the specified value?	99°C (210°F)	Go to Step 4	Go to Diagnostic Aids
4	1. Disconnect the charge receptacle 8-way connector. 2. Read the charge receptacle temperature at the Battery Pack Control Module with a scan tool. Does charge receptacle temperature read at or above the specified value?	99°C (210°F)	Go to Step 5	Go to Step 8
5	1. Connect the 20-way battery pack breakout box J 42494 to the vehicle in-line connector. 2. Open switch L. 3. Read the charge receptacle temperature at the Battery Pack Control Module with a scan tool. 4. Is charge receptacle temperature read at or above the specified value?	99°C (210°F)	Go to Step 6	Go to Step 7
6	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 9	—
7	Repair short to ground in charge receptacle circuit between the battery pack 20-way and the charge receptacle 8-way connectors. Is the action complete?	—	Go to Step 9	—
8	Replace the charge receptacle. Refer to *Charge Receptacle removal and replacement.* Is the action complete?	—	Go to Step 9	—
9	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 287 Drive Motor Battery Charger Receptacle Circuit Correlation


LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Hot At All Times
Power Distribution BA – 10
I/P Fuse Block
D6
PCM/BCM Fuse 13 10 A
E5
ORN 1040
ORN 1040
ORN 1040
ORN 1040
Fuse Block Details BA – 11
A
Charge Receptacle
Charge Paddle Present Switch
12 V Regulated
C/R TEMP Return
C/R TEMP
Class II Bus
Ground
Not Used
B
H
D
C
E
F
PPL 1807
PPL 1807
DK GRN 2023
DK BLU 660
WHT 5646
BLK 250
F
SP201
Ground Distribution Cell 14
D
PPL 1807
PPL 1807
BLK 250
8 C1
Power Inverter Module
M
L
C
C300
Drive Pack Control Module
Drive Motor Battery Assembly
264061

Circuit Description

The Drive Motor Control Module and the Battery Pack Control Module each monitor the charge receptacle paddle present switches through there own discrete inputs. This is accomplished by the paddle insertion into the charge receptacle which completes the temperature sensor circuit allowing the Battery Pack Control Module to read charge receptacle temperature. The Drive Motor Control Module also detects charge paddle present via a micro-switch located in the charge receptacle. The Drive Motor Control Module uses this information to prevent shifting out of park while the vehicle is charging. The two control modules then compare there findings over serial data. In the event that one control module Sees a different paddle present state then the other, a DTC will be set.

Conditions for Setting the DTC

- The Battery Pack Control Module and the Drive Motor Control Module do not agree on the presents of the charge paddle for 10 seconds.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Propulsion is disabled.
- Charging is disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Remove and insert the charge paddle several times while viewing both the Drive Motor Control Module and the Battery Pack Control Module. Look for the control module with the incorrect reading.
- If the charge paddle icon is not illuminated on the dash but the system is operating normally look for an open circuit to the Body Control Interface Module.
- An intermittent DTC may be caused by a sticking switch.

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	336,500
-30	-22	177,000
-20	-4	97,070
-10	14	55,330
0	32	32,650
10	50	19,900
20	68	12,490
30	86	8,057
40	104	5,327
50	122	3,603
60	140	2,488
70	158	1,752
80	176	1,258
90	194	917.7
100	212	680
110	230	511.2
120	248	389.3
130	266	300.9
140	284	234.8
150	302	185.3

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks to see if the fault is present with the charge paddle removed.
3. Checks to see if the fault is present with the charge paddle inserted.
5. Checks the paddle present signal to the Drive Motor Control Module.
8. Checks the temp sensor circuit to the charge receptacle.

DTC 287 Drive Motor Battery Charger Receptacle Circuit Correlation

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Remove the charge paddle from the charge receptacle. 2. Turn the ignition ON. 3. Using a scan tool clear the DTC(s). 4. Wait the specified time and see if the DTC resets. Did the DTC reset with the paddle removed from the charge receptacle?	1 minute	Go to Step 9	Go to Step 3
3	1. Insert the charge paddle into the charge receptacle. 2. Wait the specified time and see if the DTC resets. Did the DTC reset with the charge paddle inserted into the charge receptacle?	1 minute	Go to Step 4	Go to Diagnostic Aids
4	With the paddle still inserted into the charge receptacle, use a scan tool to view the paddle present condition as read by the Drive Motor Control Module. Does the Drive Motor Control Module read the paddle is present?	—	Go to Step 7	Go to Step 5
5	. Remove the Power Inverter Module C1 32-way connector. 2. Check pin 8 of the 32-way harness to ground with a DMM. Is the voltage at or above the specified value?	11 volts	Go to Step 17	Go to Step 6

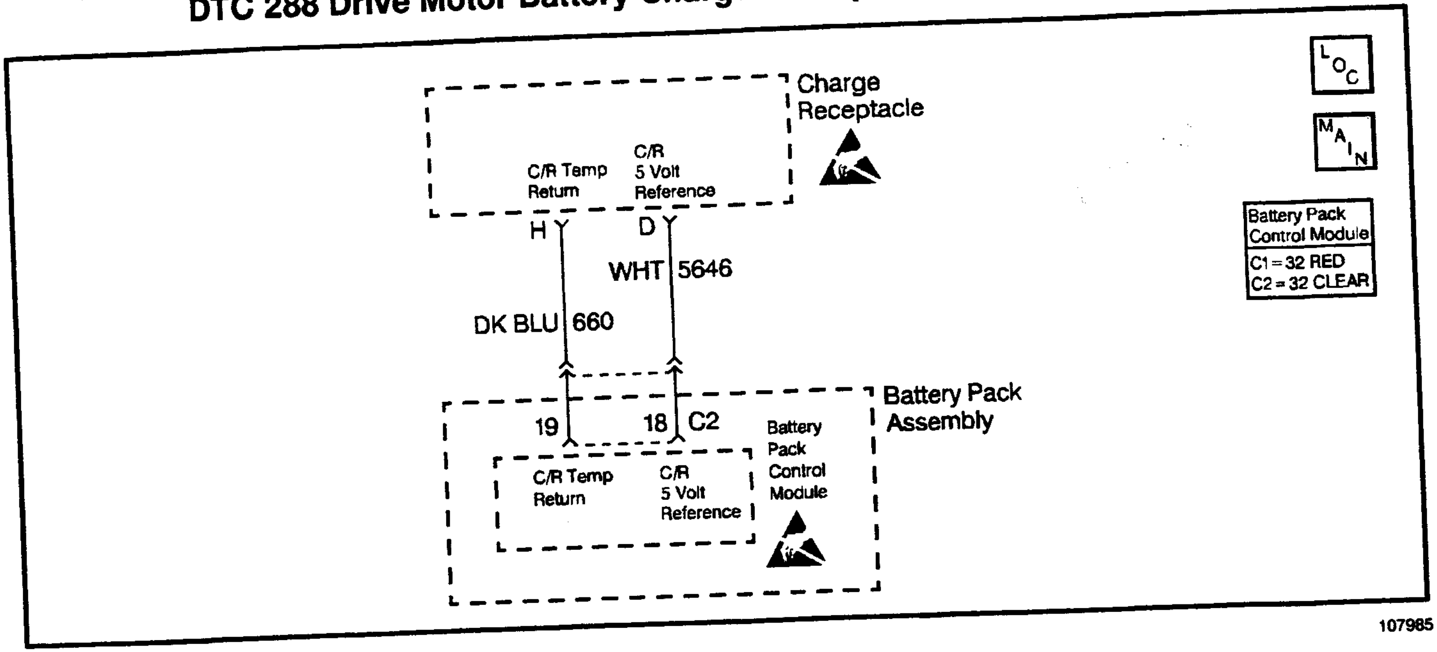
DTC 287 Drive Motor Battery Charger Receptacle Circuit Correlation (continued)

Step	Action	Value(s)	Yes	No
6	1. Remove the 8-way connector from the charge receptacle. 2. Using a DMM check for an open or short to ground between pin 8 of the Power Inverter Module 32-way harness and pin B of the charge receptacle harness. Was an open or short to ground found in circuit 2023?	—	Go to Step 15	Go to Step 18
7	1. Install the 20-way breakout box J 42494 in-line to the battery pack. 2. Insure that the charge paddle is inserted into the charge receptacle. 3. Flip the switches on pins L and M to the OPEN position. 4. Measure the resistance between pins L and M on the harness side. Is the circuit open?	—	Go to Step 8	Go to Step 14
8	1. Disconnect the 8-way charger receptacle connector. 2. Jumper pins D and H on the harness side of the connector. 3. Measure the resistance between pins L and M on the 20-way breakout box J 42494 harness side. Is the circuit open?	—	Go to Step 16	Go to Step 18
9	With the paddle removed from the charge receptacle, use a scan tool to view the paddle present condition as read by the Drive Motor Control Module. Does the Drive Motor Control Module read the paddle is present?	yes/No —	Go to Step 10	Go to Step 12
10	1. Remove the Power Inverter Module C1 32-way connector. 2. Check pin 8 of the 32-way harness to ground with a DMM. Is the voltage at or above the specified value?	11 volts	Go to Step 11	Go to Step 17
11	1. Disconnect the 8-way charge receptacle connector. 2. Check pin 8 of the Power Inverter Module 32-way harness to ground with a DMM. Is voltage still present on pin 8 of the 32-way?	—	Go to Step 15	Go to Step 18
12	1. Install the 20-way breakout box J 42494 in-line to the battery pack. 2. Insure that the charge paddle is removed from the charge receptacle. 3. Flip the switches on pins L and M to the OPEN position. 4. Measure the resistance between pins L and M on the harness side. Is the circuit open?	—	Go to Step 14	Go to Step 13

DTC 287 Drive Motor Battery Charger Receptacle Circuit Correlation (continued)

Step	Action	Value(s)	Yes	No
13	1. Disconnect the 8-way charger receptacle connector. 2. Measure the resistance between pins L and M on the 20-way breakout box J 42494 harness side. Is the circuit open?	—	Go to Step 18	Go to Step 16
14	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 15	—
15	Repair the short to voltage condition. Is the action complete?	—	Go to Step 19	—
16	Repair the open or short condition. Is the action complete?	—	Go to Step 19	—
17	Replace the Power Inverter Module. Refer to *Power Inverter Module replacement procedure.* Is the action complete?	—	Go to Step 19	—
18	Replace the charge receptacle. Refer to *charge receptacle removal and replacement.* Is the action complete?	—	Go to Step 19	—
19	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 288 Drive Motor Battery Charger Receptacle Circuit Over temp



Circuit Description

The charge receptacle contains a temperature sensor that is used to determine both the presence of the charge paddle and the temperature of the charge receptacle. When the charge receptacle temperature sensor reaches the appropriate level the HTCM is triggered to cool the charge receptacle. If charge receptacle temperature exceeds a maximum value a DTC will be set. The charge receptacle temperature sensor is internal to the charge receptacle and is not serviceable.

Conditions for Setting the DTC

- Charge paddle is present.
- Charge receptacle temperature is greater than 68°C (154°F) for 10 seconds.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the TEMP light.
- Charging will be disabled until the temperature is below 63°C (145°F).
- The charge receptacle will be cooled for 5 minutes and charging will be re-enabled after the charge receptacle temp drops below 63°C. If the temp rises above 68°C again charging is disabled permanently.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Check the cooling system to insure the charge receptacle is getting coolant.
- Check the charge receptacle coolant valve for proper operation. The valve lever should move when aux. battery power is disconnected and reconnected.
- If HTCM DTC(s) are set along with Battery Pack Control Module DTC 288 this indicates a cooling problem. Refer to HTCM DTC(s) first.

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	336,500
-30	-22	177,000
-20	-4	97,070
-10	14	55,330
0	32	32,650
10	50	19,900
20	68	12,490
30	86	8,057
40	104	5,327
50	122	3,603
60	140	2,488
70	158	1,752
80	176	1,258
90	194	917.7
100	212	680
110	230	511.2
120	248	389.3
130	266	300.9
140	284	234.8
150	302	185.3

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

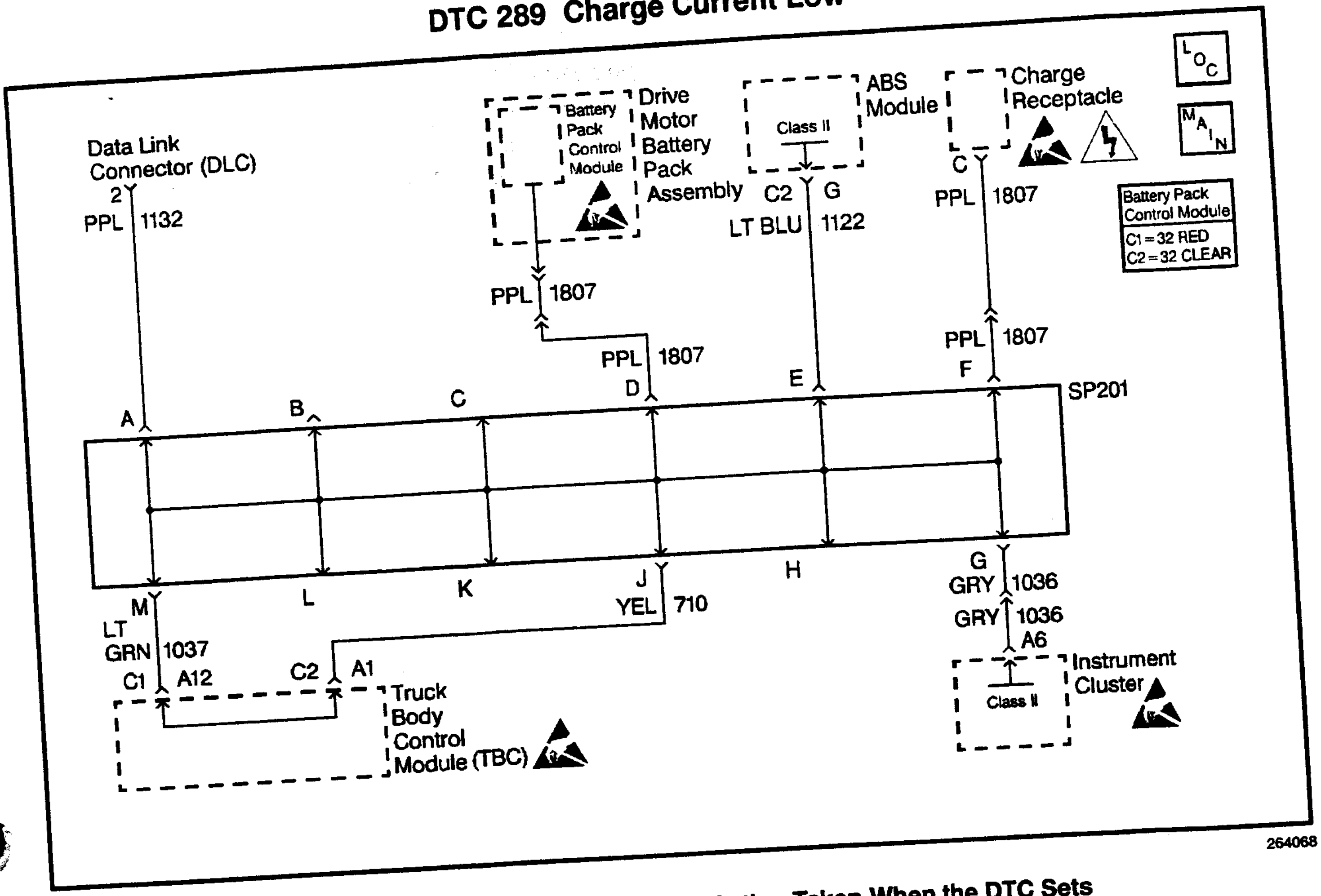
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Any coolant faults should be fixed first.
4. Checks for a fault with the charge receptacle temperature sensor.
5. 2000 ohms is the DTC set point.
6. Checks the temperature sensor circuit.

DTC 288 Drive Motor Battery Charger Receptacle Circuit Over temp

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Install the charge paddle into the charge receptacle. 2. Clear the DTC. 3. Attempt to charge the vehicle to FULL. Did the DTC reset?	—	Go to Step 3	Go to Diagnostic Aids
3	Are any HTCM DTC(s) also set?	—	Go to other DTC(s) first	Go to Step 4
4	Is Battery Pack Control Module DTC 286 also set?	—	Go to other DTC first	Go to Step 5
5	1. Drive the vehicle until the user state of charge is less then 25%. 2. Charge the vehicle until DTC 288 resets. 3. Disconnect the charge receptacle connector and measure the resistance between pins D and H on the charge receptacle. Is the resistance less than the specified value?	2000 ohms	Go to Step 8	Go to Step 6
6	1. Reconnect the charge receptacle 8-way connector. 2. Install the 20-way breakout box J 42494 in-line to the battery pack. 3. Insure that the charge paddle is inserted into the charge receptacle. 4. Flip the switches on pins L and M to the OPEN position. 5. Measure the resistance between pins L and M on the vehicle harness side. Is the resistance the same as the reading in step 5?	—	Go to Step 7	Go to Diagnostic Aids
7	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 9	—
8	If no other HTCM DTC(s) have set and the cooling system is operating properly, replace the charge receptacle. Refer to *charge receptacle removal and replacement.* Is the action complete?	—	Go to Step 9	Go to Diagnostic Aids
9	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 289 Charge Current Low


Data Link Connector (DLC)
2
PPL 1132
Battery Pack Control Module
Drive Motor Battery Pack Assembly
PPL 1807
ABS Module
Class II
C2 G
LT BLU 1122
Charge Receptacle
C
PPL 1807
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
PPL 1807
D
PPL 1807
E
F
SP201
A
B
C
M
L
K
J
H
G
YEL 710
GRY 1036
GRY 1036
A6
LT GRN 1037
C1 A12
C2 A1
Truck Body Control Module (TBC)
Instrument Cluster
Class II
264068

Circuit Description

During charging the Battery Pack Control Module reviews the condition of the battery modules and determines the level of current that the battery pack needs. This class II message is transmitted to the charger through the Radio frequency communications system. If the Battery Pack Control Module does not see current when commanded during charging a DTC will set.

Conditions for Setting the DTC

- Charge paddle present.
- Battery Pack Control Module is requesting power from the charger.
- Less then Zero (0) amps battery pack current is detected for 45 seconds after current is commanded.

Or

- Five or more occurrences of Battery Pack Control Module DTC 290.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.
- Charging is disabled.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Use a scan tool and view the charge event history table for information on the charging event.
- Check the class II data line and all vehicle grounds. This DTC can set if there is nose on the class II line.
- Charge the vehicle from a low SOC to FULL with a different charger. If the DTC will not reset the fault may be in the previous charger.
- Low Aux battery voltage may cause this DTC to set. If the Aux battery is low disregard this DTC and charge the Aux Battery.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

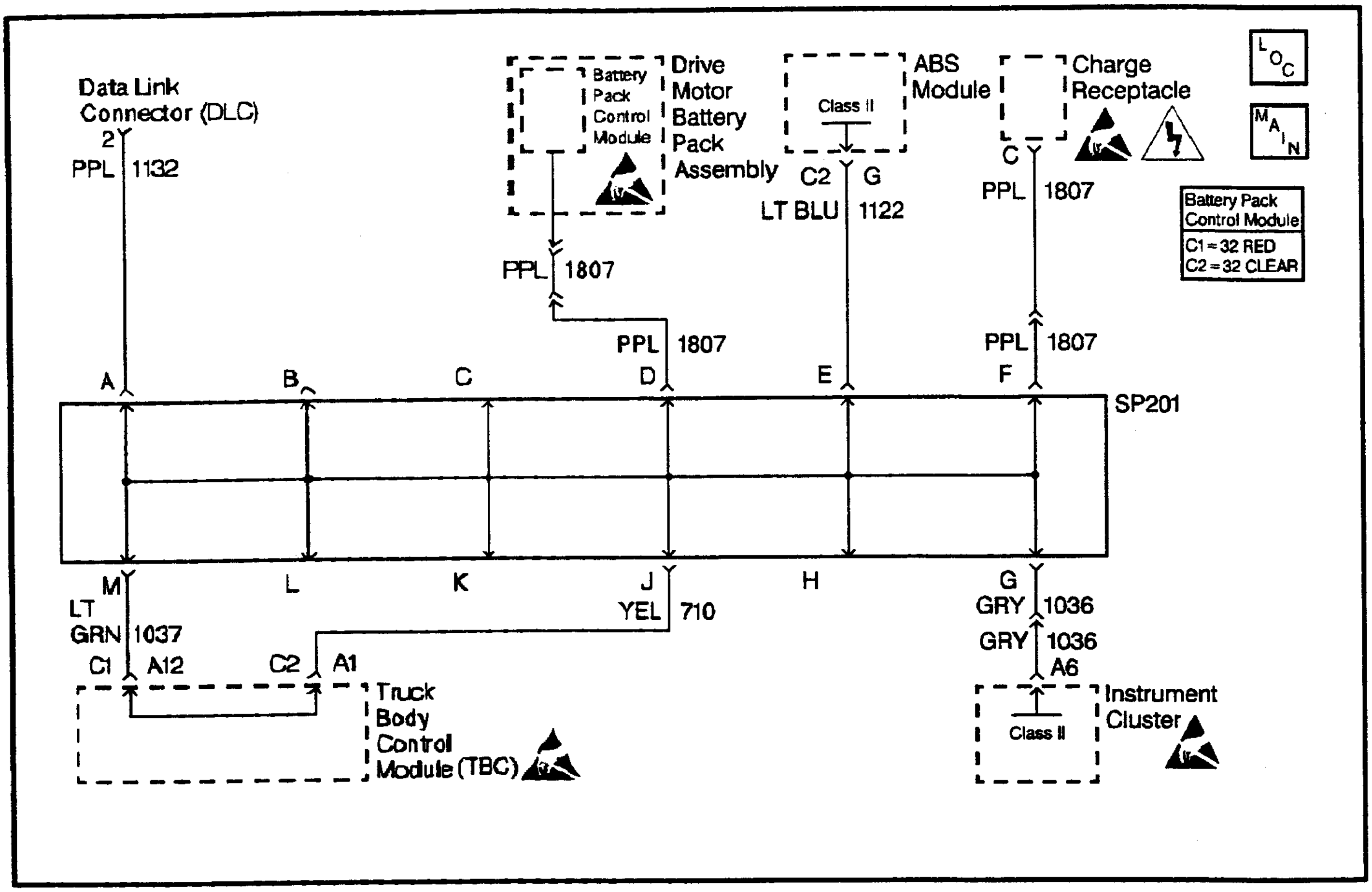
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the shunt is not functioning properly this DTC will set.
4. Check to see if the fault is present.
5. Checks for a faulty charger.
6. Check for any device that may be drawing charger current.

DTC 289 Charge Current Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any Battery Pack Control Module shunt DTC(s) also set?		Go to other DTC first	Go to Step 3
3	Is Battery Pack Control Module DTC 290 also set?	—	Go to other DTC first	Go to Step 4
4	Is DTC 289 current?	—	Go to Step 5	Go to Diagnostic Aids
5	1. Remove the current charger. 2. Clear the DTC. 3. Plug in another charger. Does vehicle charge without DTC resetting?	—	Go to Step 9	Go to Step 6
6	Check the Aux. Battery for a low charge. Was the Aux. Battery charge low?	—	Go to Step 11	Go to Step 7
7	Check the vehicle high voltage components for excessive loads Were any devices found to be drawing excessive current?	—	Go to Step 10	Go to Step 8
8	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 12	—
9	Charger problem. Call for service. Is the action complete?	—	Go to Step 12	—
10	Replace the faulty component. Is the action complete?		Go to Step 12	
11	Refer to Auxiliary battery section for low battery condition. Is the action complete?		Go to Step 12	
12	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 290 Charge Current High


Data Link Connector (DLC)
2
PPL 1132
Battery Pack Control Module
Drive Motor Battery Pack Assembly
PPL 1807
PPL 1807
Class II
ABS Module
C2 G
LT BLU 1122
Charge Receptacle
C
PPL 1807
PPL 1807
LOC
MAIN
Battery Pack Control Module
C1 = 32 RED
C2 = 32 CLEAR
A B C D E F
SP201
M L K J H G
LT GRN 1037
C1 A12
C2 A1
YEL 710
Truck Body Control Module (TBC)
GRY 1036
GRY 1036
A6
Class II
Instrument Cluster

264068

Circuit Description

During charging the Battery Pack Control Module reviews the condition of the battery modules and determines the level of current that the battery pack needs. This class II message is transmitted to the charger through the Radio frequency communications system. If the Battery Pack Control Module requests 0 power after charging is initiated a DTC will set.

Conditions for Setting the DTC

- Battery Pack Control Module requests 0 power after charging is initiated.

Action Taken When the DTC Sets

- The Battery Pack Control Module requests Zero (0) power during charging. The Battery Pack Control Module will then cycle back on to finish the charge. If minimum charger output is still to high the Battery Pack Control Module will continue to cycle the charger on and off.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function

Diagnostic Aids

Check for the following conditions:

- Use the scan tool a review the charger event history table for information on the charging event.
- This DTC normally sets during the end of charge when a lower power request is coming from the Battery Pack Control Module.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

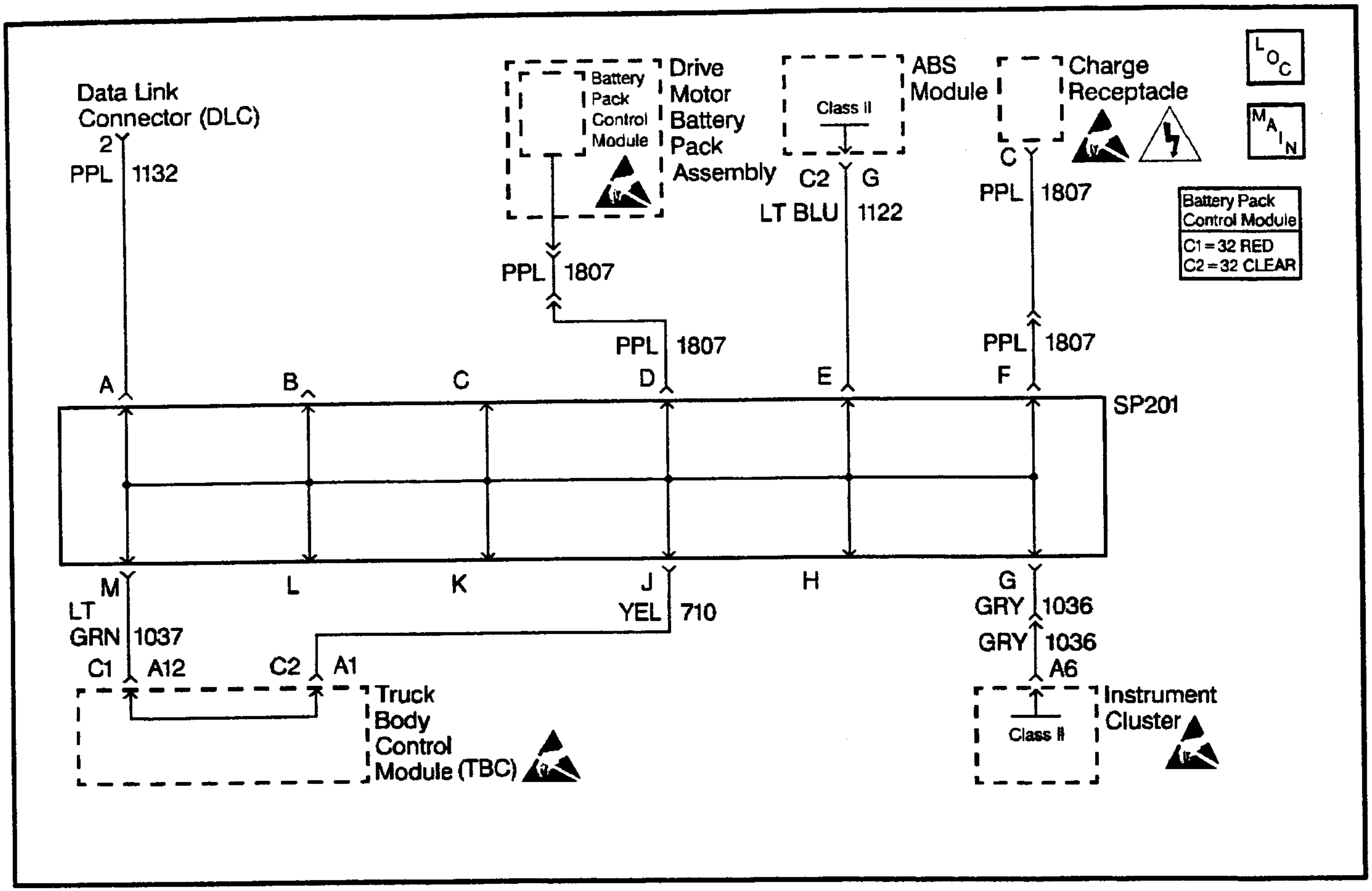
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the shunt is not functioning properly this DTC will set.
4. Checks for a faulty charger.

DTC 290 Charge Current High

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any other Battery Pack Control Module shunt DTC(s) also set?	—	Go to other DTC(s) first	Go to Step 3
3	Is DTC 290 current?	—	Go to Step 4	Go to Diagnostic Aids
4	1. Remove the current charger. 2. Clear the DTC. 3. Plug in another charger. Did the DTC reset?	—	Go to Step 5	Go to Step 6
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 7	—
6	Charger problem. Call for service. Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 291 Unintended Charging with Charge Paddle


Data Link Connector (DLC)
2
PPL 1132
Battery Pack Control Module
Drive Motor Battery Pack Assembly
PPL 1807
PPL 1807
Class II
ABS Module
C2 G
LT BLU 1122
Charge Receptacle
C
PPL 1807
PPL 1807
L OC
M A I N
Battery Pack Control Module
C1 = 32 RED
C2 = 32 CLEAR
A
B
C
D
E
F
SP201
M
L
K
J
H
G
LT GRN 1037
C1 A12
C2 A1
YEL 710
GRY 1036
GRY 1036
A6
Truck Body Control Module (TBC)
Class II
Instrument Cluster

264068

Circuit Description

When the charge paddle is inserted into the charge receptacle, vehicle wake-up is sent to the Battery Pack Control Module and class II information is transferred between Battery Pack Control Module and charger. The charger and Battery Pack Control Module initialize and transfer system status before power can be transferred to the battery pack. The Battery Pack Control Module will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

Conditions for Setting the DTC

- The Charge paddle is present
- Battery Pack Control Module requesting Zero (0) power
- Battery pack current is greater than Zero (0) amps for 5 seconds

Action Taken When the DTC Sets

- Charging is disabled.
- The auto disconnect opens the high voltage relays.
- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

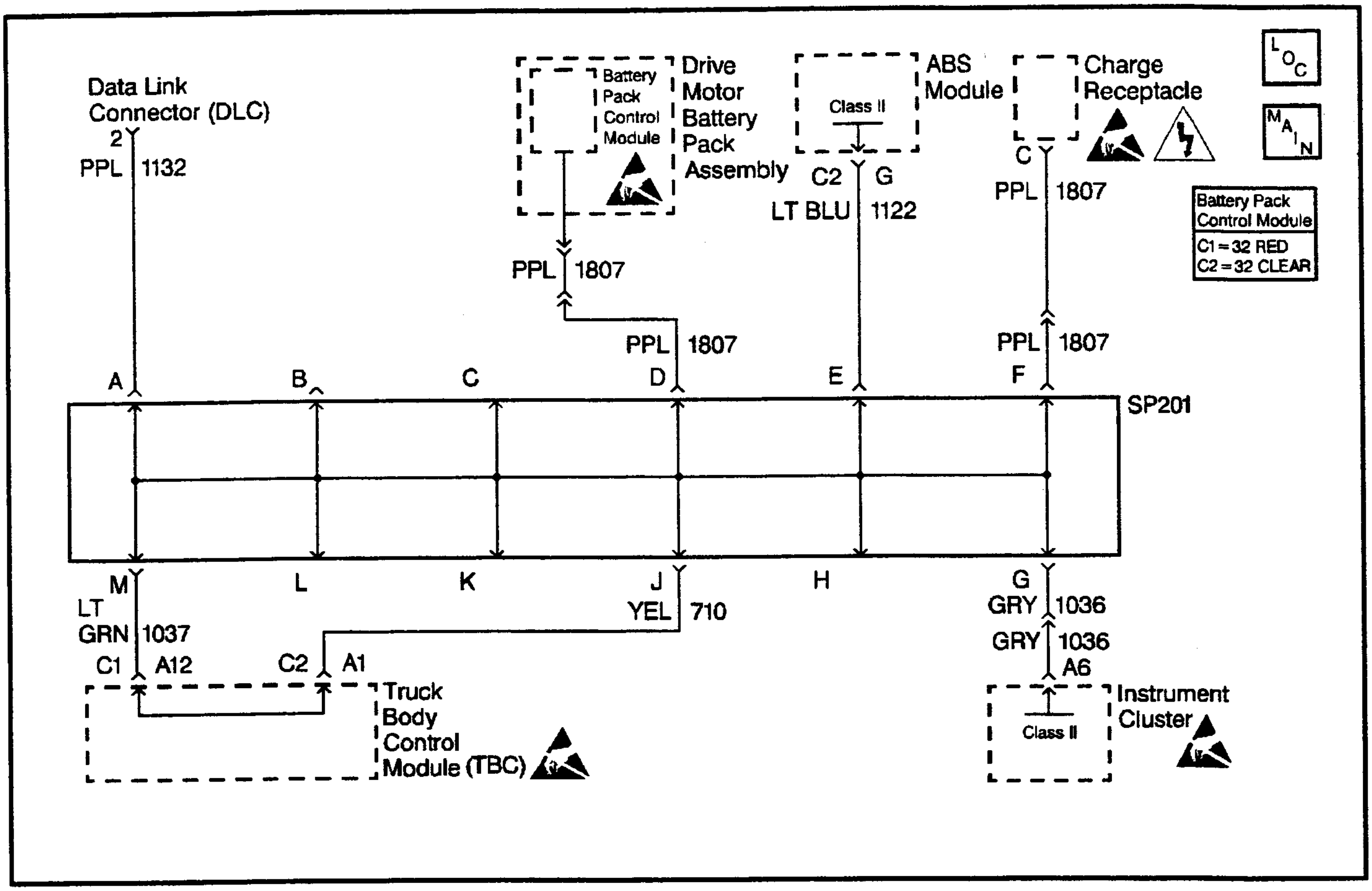
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for charger faults.
4. Checks to see if the fault is present.
5. Checks for a faulty charger.

DTC 291 Unintended Charging with Charge Paddle

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are Battery Pack Control Module DTC(s) 293, 294, or 295 set?	—	Go to other DTC(s) first	Go to Step 3
3	Are Battery Pack Control Module shunt DTC(s) set?	—	Go to other DTC(s) first	Go to Step 4
4	Is DTC 291 current?	—	Go to Step 5	Go to Diagnostic Aids
5	1. Clear DTC(s) 2. Plug in another charger. Does the DTC reset?	—	Go to Step 6	Go to Step 7
6	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 8	—
7	Charger problem. Call for service. Is the action complete?	—	Go to Step 8	—
8	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 292 Unintended Charging with Out Charge Paddle


Data Link Connector (DLC)
2
PPL 1132
Battery Pack Control Module
Drive Motor Battery Pack Assembly
PPL 1807
PPL 1807
Class II
ABS Module
C2 G
LT BLU 1122
Charge Receptacle
C
PPL 1807
PPL 1807
LOC
MAIN
Battery Pack Control Module
C1 = 32 RED
C2 = 32 CLEAR
A
B
C
D
E
F
SP201
M
L
K
J
H
G
LT GRN 1037
YEL 710
GRY 1036
GRY 1036
C1 A12
C2 A1
A6
Truck Body Control Module (TBC)
Class II
Instrument Cluster

264068

Circuit Description

When the charge paddle is inserted into the charge receptacle, vehicle wake-up is sent to the Battery Pack Control Module and class II information is transferred between Battery Pack Control Module and charger. The charger and Battery Pack Control Module initialize and transfer system status before power can be transferred to the battery pack. The Battery Pack Control Module will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

Conditions for Setting the DTC

- Charge paddle is not present.
- Vehicle is in park.
- The Battery Pack Control Module see current going into the battery pack.

Action Taken When the DTC Sets

- Charging is disabled.
- Propulsion is disabled.
- The auto disconnect opens the high voltage relays.
- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Check for evidence of tampering with the charging system.
- This DTC can set if an attempt is made to charge the battery pack from an outside source.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

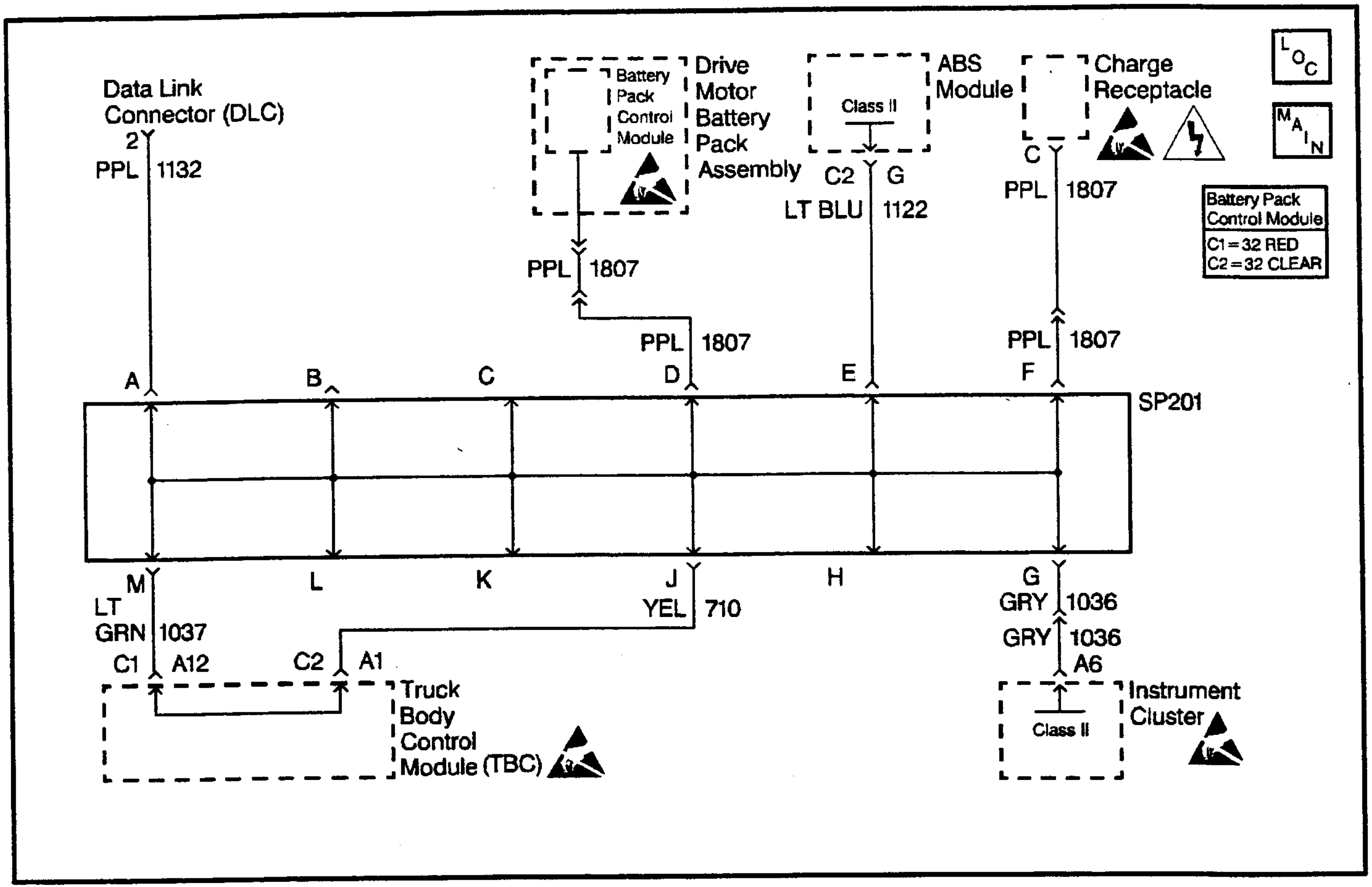
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks to see if the fault is present.

DTC 292 Unintended Charging with Out Charge Paddle

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are Battery Pack Control Module or Drive Motor Control Module DTC(s) also set?	—	Go to other DTC(s) first	Go to Step 3
3	Is DTC 292 current?	—	Go to Step 4	Go to Diagnostic Aids
4	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 5	—
5	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 293 Charger Fault


Data Link Connector (DLC)
2
PPL 1132
Battery Pack Control Module
Drive Motor Battery Pack Assembly
PPL 1807
Class II
ABS Module
C2 G
LT BLU 1122
Charge Receptacle
C
PPL 1807
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
PPL 1807
PPL 1807
A
B
C
D
E
F
SP201
M
L
K
J
H
G
LT GRN 1037
C1 A12
C2 A1
YEL 710
GRY 1036
GRY 1036
A6
Truck Body Control Module (TBC)
Class II
Instrument Cluster

264068

Circuit Description

When the charge paddle is inserted into the charge receptacle, vehicle wake-up is sent to the Battery Pack Control Module and class II information is transferred between Battery Pack Control Module and charger. The charger and Battery Pack Control Module initialize and transfer system status before power can be transferred to the battery pack. The Battery Pack Control Module will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

Conditions for Setting the DTC

- The charger is indicating a hardware fault by class II.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

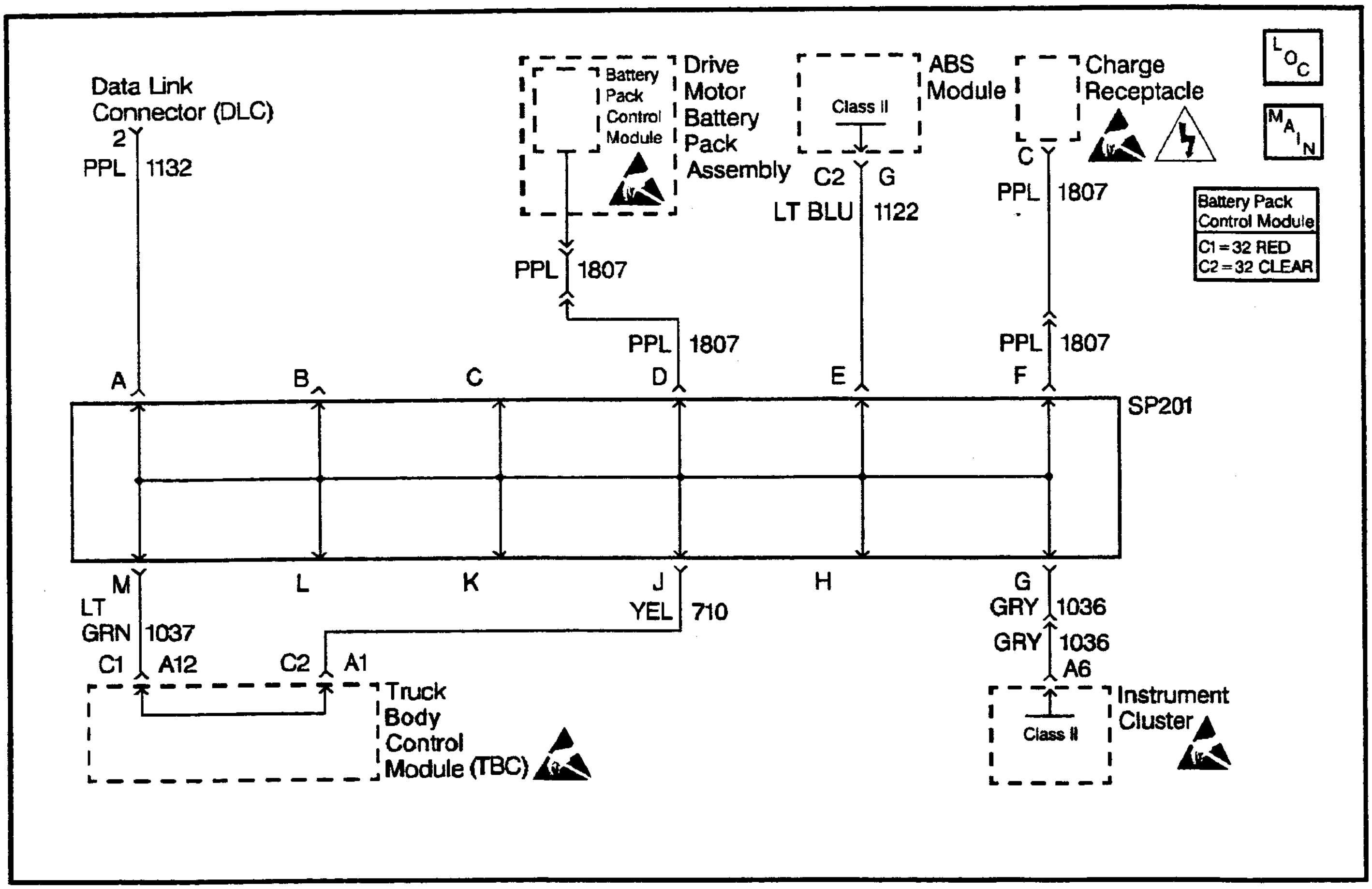
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks charger operation.

DTC 293 Charger Fault

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are any other DTC(s) set?	—	Go to Other DTC(s) first	Go to Step 3
3	1. Clear DTC(s) 2. Plug in another charger. Does the vehicle charge?	—	Go to Step 4	Go to Step 5
4	Charger problem. Call for service. Is the action complete?	—	Go to Step 6	—
5	Replace the charge receptacle. Refer to *charge receptacle removal and installation.*	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 294 Charger Communication Fault



Data Link Connector (DLC)
2
PPL 1132
Battery Pack Control Module
Drive Motor Battery Pack Assembly
PPL 1807
ABS Module
Class II
C2 G
LT BLU 1122
Charge Receptacle
C
PPL 1807
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
A B C D E F
SP201
M L K J H G
LT GRN 1037
C1 A12
C2 A1
YEL 710
GRY 1036
A6
Truck Body Control Module (TBC)
Instrument Cluster
Class II

264068

Circuit Description

When the charge paddle is inserted into the charge receptacle, vehicle wake-up is sent to the Battery Pack Control Module and class II information is transferred between Battery Pack Control Module and charger. The charger and Battery Pack Control Module initialize and transfer system status before power can be transferred to the battery pack. The Battery Pack Control Module will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

Conditions for Setting the DTC

- The charger has three occurrences of not receiving data for 250 milliseconds.

Action Taken When the DTC Sets

- Charger will display CHECK CHARGER.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Check the ABS controller for a class II fault.
- To check for activity on the class II data line probe pin 2 on the ALDL connector under the dash.
- Look for this DTC to set near the end of the charge event.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

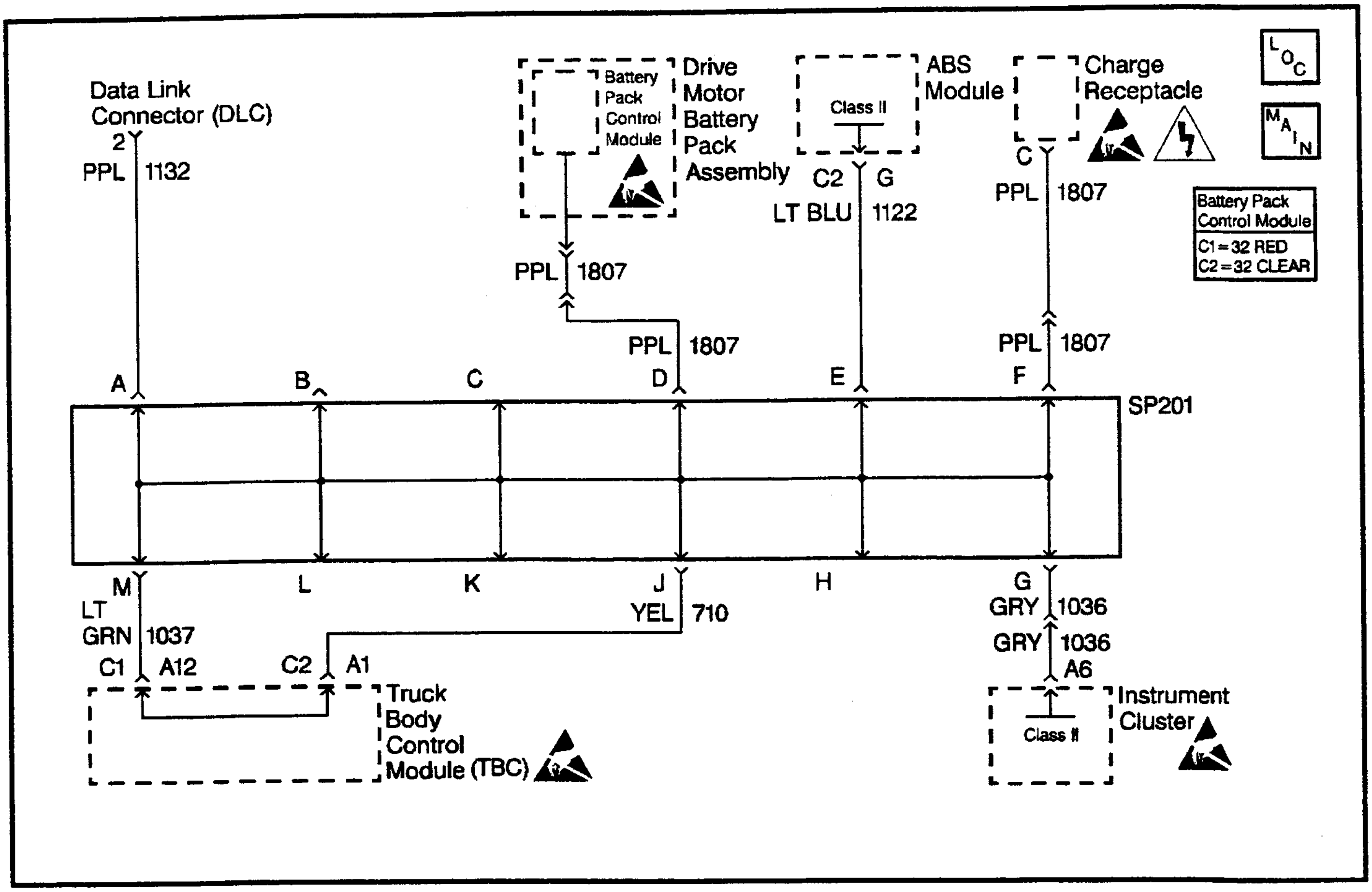
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for a charger problem.
3. Looks for a class II communication fault.

DTC 294 Charger Communication Fault

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Clear DTC(s) 2. Plug in another charger. Does the vehicle charge?	—	Go to Step 7	Go to Step 3
3	Check class II circuits for intermittent open or short to ground. Was a problem found?	—	Go to Step 5	Go to Step 4
4	Try the original charger on a known good vehicle. Did the DTC set on the second vehicle?	—	Go to Step 6	Go to Step 7
5	Repair the class II circuit. Is the action complete?	—	Go to Step 8	—
6	Replace the charge receptacle. Refer to *charge receptacle removal and installation.*	—	Go to Step 8	—
7	Charger problem. Call for service. Is the action complete?	—	Go to Step 8	—
8	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 295 Drive Motor Battery Charge Performance


Data Link Connector (DLC)
2
PPL 1132
Battery Pack Control Module
Drive Motor Battery Pack Assembly
PPL 1807
PPL 1807
Class II
ABS Module
C2 G
LT BLU 1122
Charge Receptacle
C
PPL 1807
PPL 1807
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
A B C D E F
SP201
M L K J H G
LT GRN 1037
C1 A12
C2 A1
YEL 710
GRY 1036
GRY 1036
A6
Truck Body Control Module (TBC)
Class II
Instrument Cluster

264068

Circuit Description

When the charge paddle is inserted into the charge receptacle, vehicle wake-up is sent to the Battery Pack Control Module and class II information is transferred between Battery Pack Control Module and charger. The charger and Battery Pack Control Module initialize and transfer system status before power can be transferred to the battery pack. The Battery Pack Control Module will then send to the charger a percentage of maximum power required for charging. This information will be updated as the vehicle charges to complete.

Conditions for Setting the DTC

- The Battery Pack Control Module has recorded Five (5) faults during a charging event.

Action Taken When the DTC Sets

- Charging is disabled.
- Charger will display CHECK CHARGER.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- If this DTC is a history code the problem may be with a charger that was used during a different charge event.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

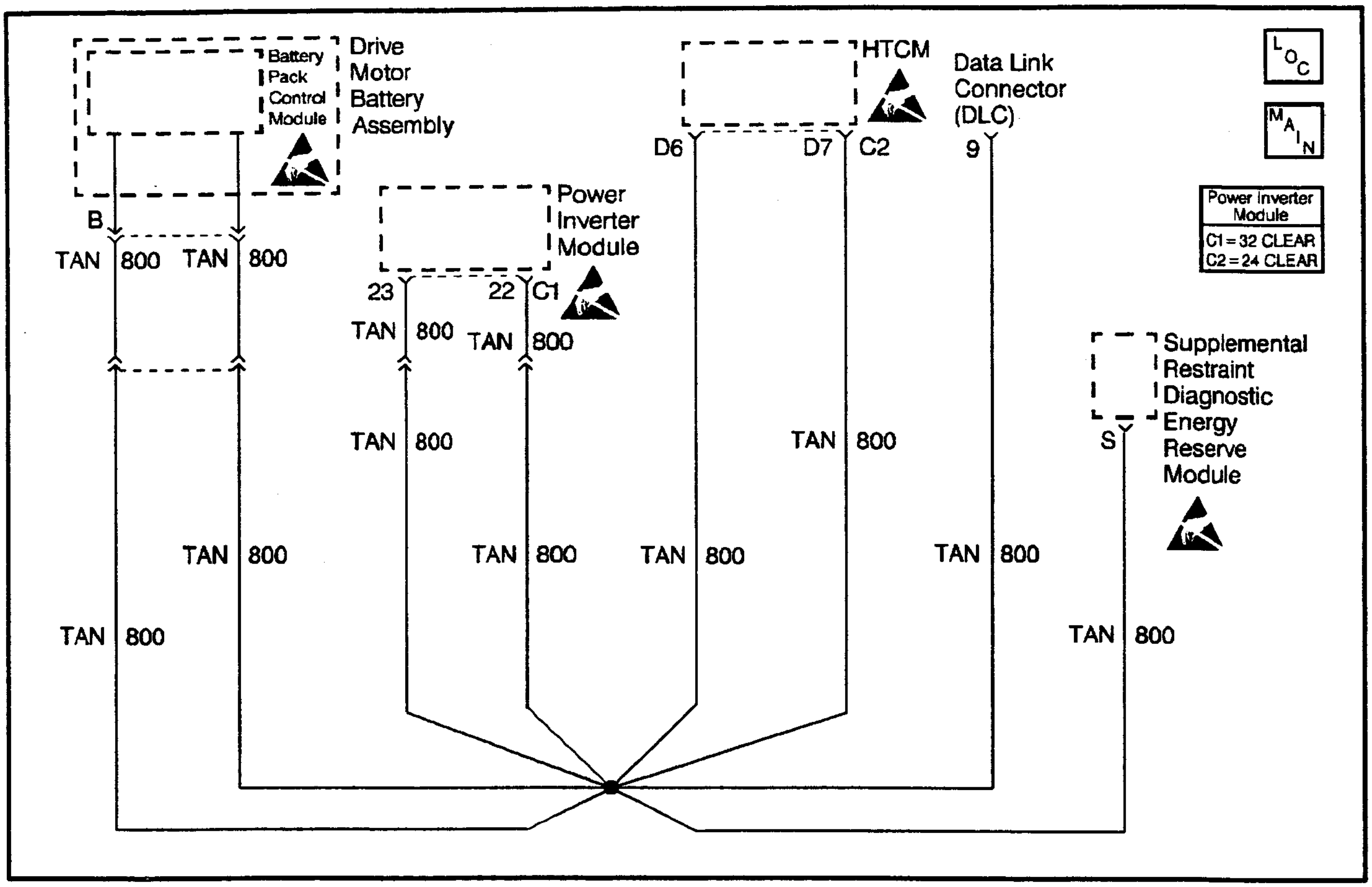
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This DTC set along with other Battery Pack Control Module DTC(s).

DTC 295 Drive Motor Battery Charge Performance

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Refer to other Battery Pack Control Module charger DTC(s).	—	Go to other DTC(s) first	—

DTC 296 HTCM Charge Inhibit


Battery Pack Control Module
Drive Motor Battery Assembly
HTCM
Data Link Connector (DLC)
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Power Inverter Module
Supplemental Restraint Diagnostic Energy Reserve Module
B
D6
D7
C2
9
23
22
C1
S
TAN
800

264084

Circuit Description

The HTCM transfers information over serial data to the Battery Pack Control Module. This information is used by the Battery Pack Control Module to determine if charging can take place. The Battery Pack Control Module will inhibit charging based on HTCM APM failure, HTCM regeneration disable, or no coolant present.

Conditions for Setting the DTC

- The Heat Thermal Control Module has indicated a failure which inhibits charging.

Action Taken When the DTC Sets

- Charging is disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- If the fault conditions are no longer present the DTC will clear form current. The vehicle will then return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- HTCM DTC(s).
- Accessory Power Control Module DTC(s) from any control module.
- Low coolant.
- HTCM recognizes a over temp condition.
- Refer to *Intermittents* Symptom table in order to diagnose intermittent problems.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

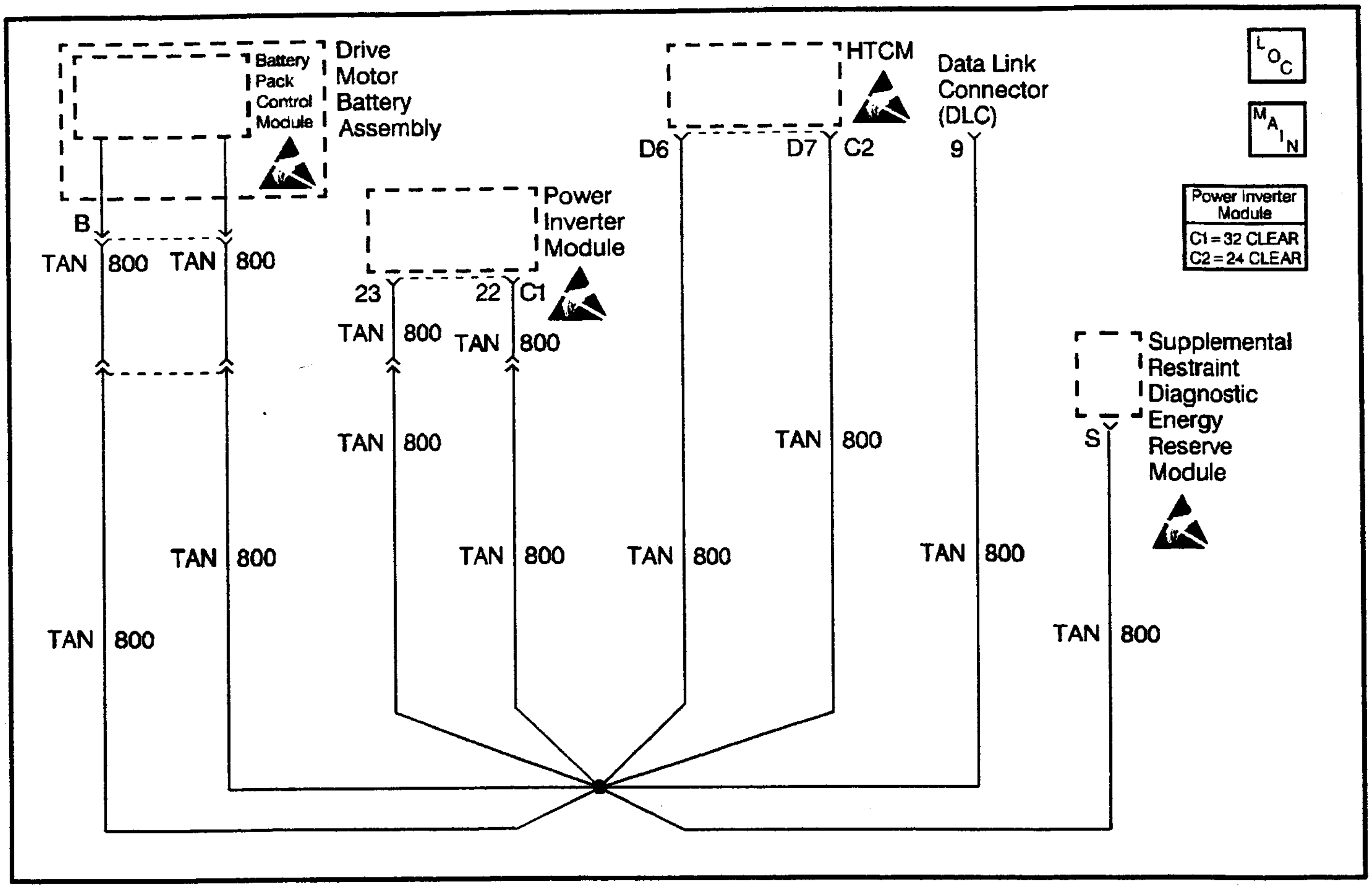
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Refer to HTCM section.

DTC 296 HTCM Charge Inhibit

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is DTC 296 current?	—	Go to Step 3	Go to Diagnostic Aids
3	Are any HTCM DTC(s) present?	—	Go to other DTC(s) first	Go to Step 4
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 300 HTCM Communication



Battery Pack Control Module
Drive Motor Battery Assembly
HTCM
Data Link Connector (DLC)
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Power Inverter Module
Supplemental Restraint Diagnostic Energy Reserve Module
B
D6
D7
C2
9
23
22
C1
S
TAN 800

264084

Circuit Description

All of the controllers communicate over the UART line. The Battery Pack Control Module is the master of the UART line and will request information from each controller in a specified order. All other controllers listen on the line for information required to perform their operations.

Conditions for Setting the DTC

- Ignition ON.
- The Battery Pack Control Module has requested information from the HTCM and there is no response for 10 seconds.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- When the fault conditions are no longer present The DTC will clear from current, and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The UART data network is designed with and redundant strategy. In order for only one control module to be cut off from communications, both data lines would have to be damaged.
- A grounded data line would pull the entire UART network low causing no communications with any control modules.
- Check for a loose or damaged C2 connector before replacing any control module.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

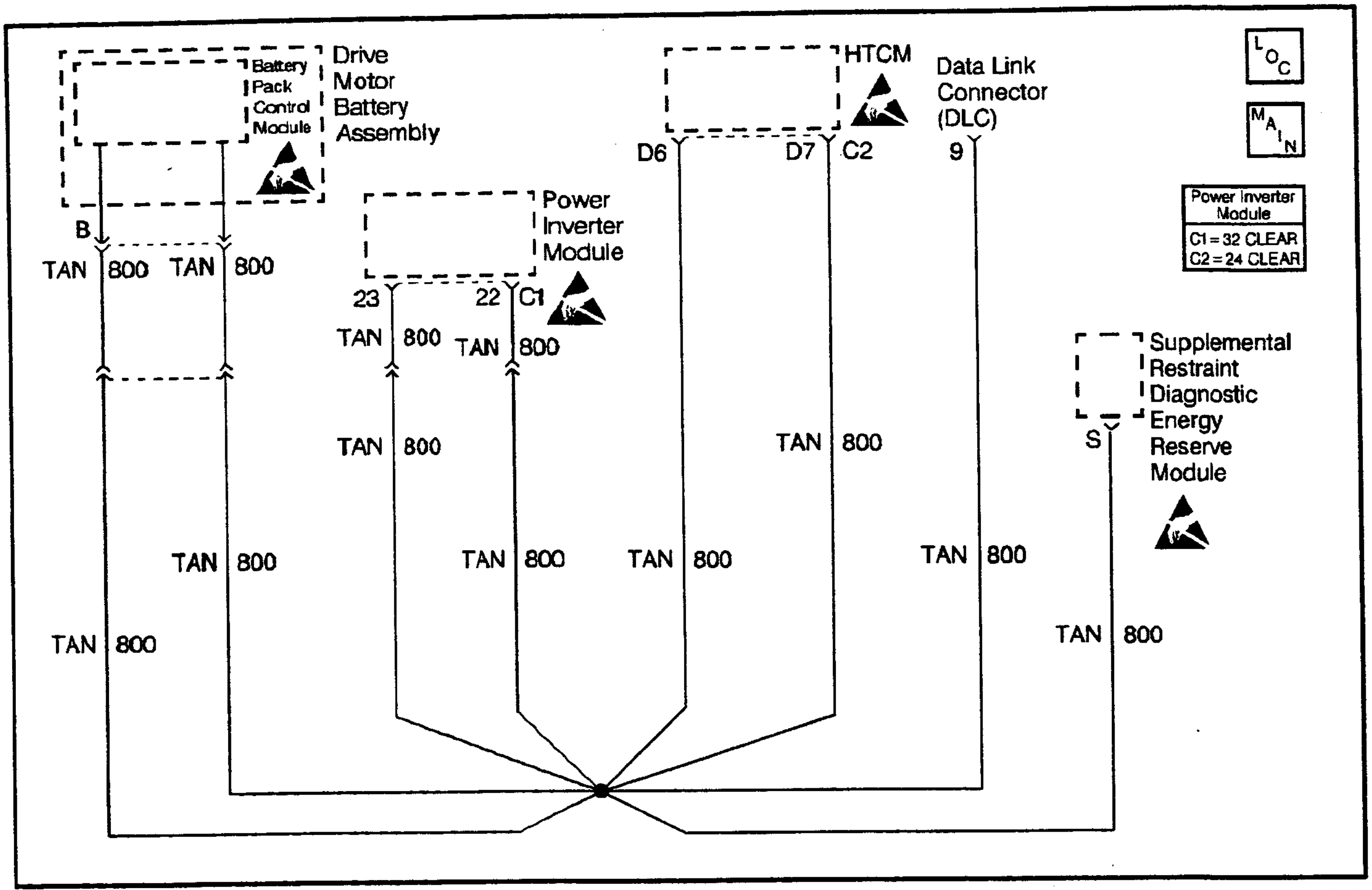
Number(s) below refer to the step number(s) on the Diagnostic Table.

4. Checks for other control modules reporting the same problem.

DTC 300 HTCM Communication

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Clear all DTC(s) 2. Cycle the key OFF then ON. Did Battery Pack Control Module DTC 300 reset?	—	Go to Step 3	Go to Diagnostic Aids
3	Is Drive Motor Control Module DTC 029 current with no other loss of communications DTC(s) set?	—	Go to Step 5	Go to Step 4
4	Are any other serial data DTC(s) set relating to loss of communications with other control modules?	—	Go to No Serial Data Table	Go to Step 6
5	Replace the HTCM. Refer to *HTCM removal and replacement.*	—	Go to Step 7	—
6	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 7	—
7	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 301 Drive Motor Control Module Communication


Battery Pack Control Module
Drive Motor Battery Assembly
B
TAN 800
TAN 800
Power Inverter Module
23
22
C1
HTCM
D6
D7
C2
Data Link Connector (DLC)
9
LOC
MAIN
Power Inverter Module
C1 = 32 CLEAR
C2 = 24 CLEAR
Supplemental Restraint Diagnostic Energy Reserve Module
S
TAN 800

264084

Circuit Description

All of the controllers communicate over the UART data line. The Battery Pack Control Module is the master of the UART line and will request information from each controller in a specified order. All other controllers listen on the line for information required to perform their operations.

Conditions for Setting the DTC

- Ignition ON.
- The Battery Pack Control Module is not receiving valid serial data messages from the Drive Motor Control Module for 10 seconds.

Action Taken When the DTC Sets

- The Battery Pack Control Module will operate on default values.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- When the fault conditions are no longer present The DTC will clear from current, , and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- The UART data network is designed with and redundant strategy. In order for only one control module to be cut off from communications, both data lines would have to be damaged.
- A grounded data line would pull the entire UART network low causing no communications with any control modules.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

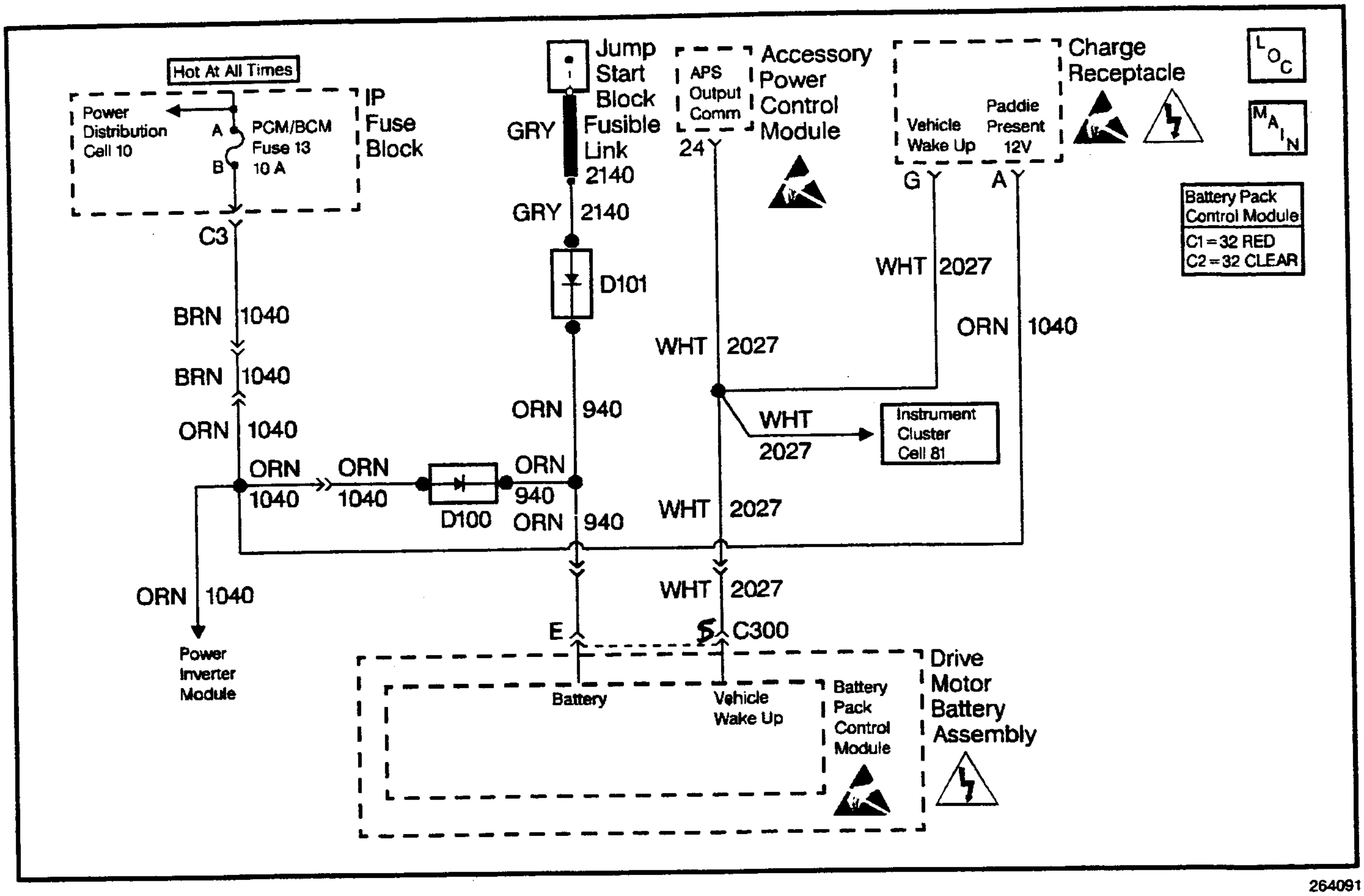
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Looks for other Drive Motor Control Module DTC(s).

DTC 301 Drive Motor Control Module Communication

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Clear all DTC(s) 2. Cycle the key OFF then ON. 3. Check for other Drive Motor Control Module serial data DTC(s). Are any other serial data DTC(s) set?	—	Go to other DTC(s) first	Go to Step 3
3	Did Battery Pack Control Module DTC 301 reset?	—	Go to Step 4	Go to Diagnostic Aids
4	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 5	—
5	Clear DTC's. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 302 Battery Pack Control Module Reset


Hot At All Times
Power Distribution Cell 10
A
PCM/BCM Fuse 13 10 A
B
IP Fuse Block
C3
BRN 1040
BRN 1040
ORN 1040
ORN 1040
ORN 1040
ORN 1040
Power Inverter Module
Jump Start Block Fusible Link 2140
GRY
GRY 2140
D101
ORN 940
ORN 940
D100
ORN 940
APS Output Comm
24
Accessory Power Control Module
WHT 2027
WHT 2027
Instrument Cluster Cell 81
WHT 2027
WHT 2027
Vehicle Wake Up
Paddle Present 12V
G
A
Charge Receptacle
WHT 2027
ORN 1040
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
E
C300
Battery
Vehicle Wake Up
Battery Pack Control Module
Drive Motor Battery Assembly

264091

Circuit Description

In order for the Battery Pack Control Module to maintain memory it receives a 12 volt power supply from the auxiliary battery. This power is used when the vehicle is powered off or during charging with the Accessory Power Module off. When the Battery Pack Control Module powers down it goes through a shut down sequence and stores away information for the next power-up cycle.

Conditions for Setting the DTC

- The Battery Pack Control Module abnormally reset during operation.

Action Taken When the DTC Sets

- SERVICE NOW light will flash each time the Battery Pack Control Module attempts to reset.
- The POWER USE gauge will toggle each time the Battery Pack Control Module attempts to reset.
- The SOC gauge will be inaccurate until the vehicle is charged.
- The pack volts gauge will toggle each time the Battery Pack Control Module attempts to reset.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- When the fault conditions are no longer present The DTC will clear from current, and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- If the battery power feed is interrupted while the Battery Pack Control Module is awake this DTC will be set. Check for a intermittent condition on circuit 940.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

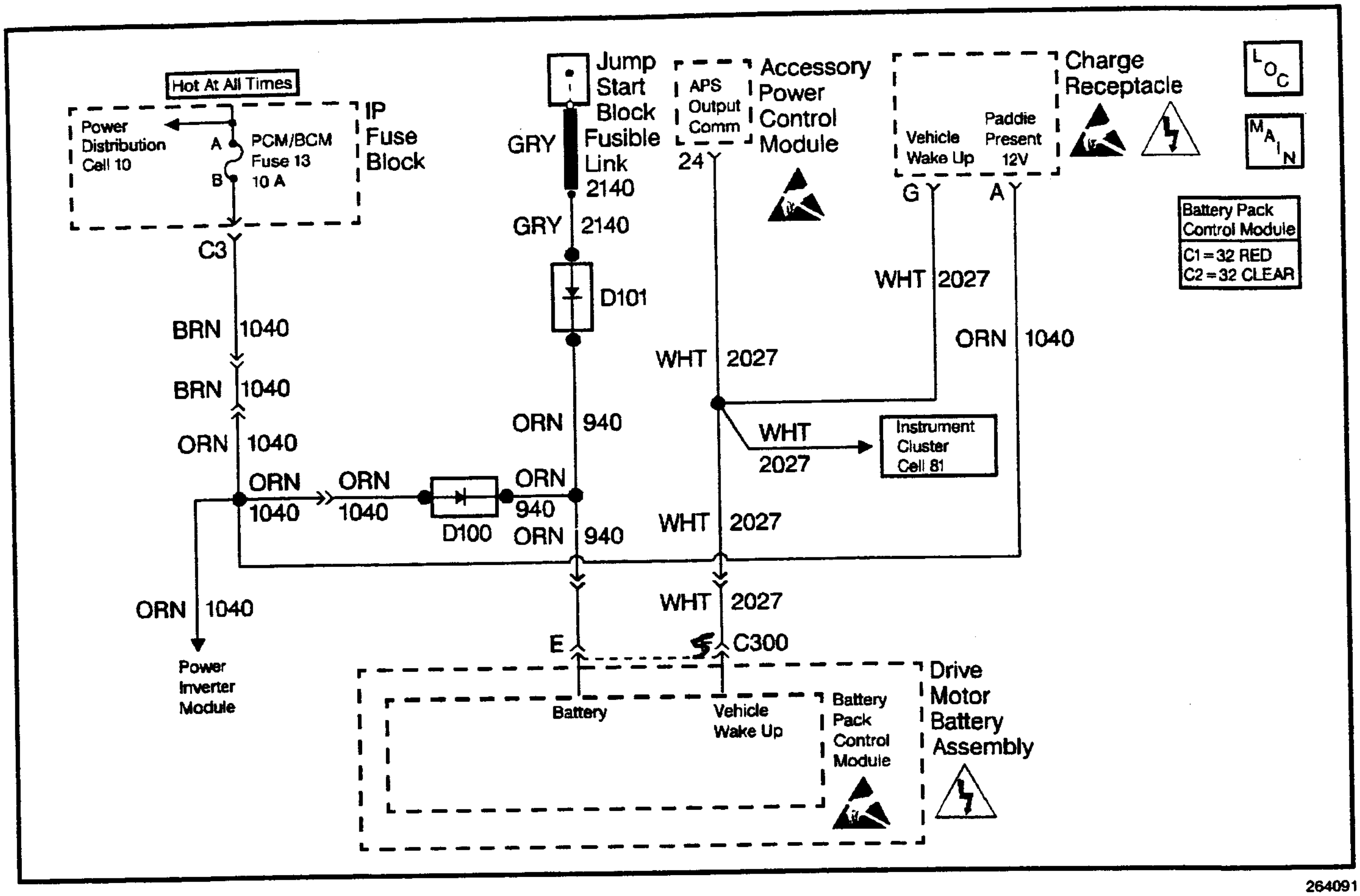
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. A low voltage supply may set this DTC.

DTC 302 Battery Pack Control Module Reset

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is Battery Pack Control Module DTC 311 also set?	—	Go to other DTC first	Go to Step 3
3	Check for an intermittent open condition on the voltage feed circuit 940. Was a problem found on circuit 940?	—	Go to Step 4	Go to Step 5
4	Repair the open condition on circuit 940. Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 303 Battery Pack Control Module Circuit


Hot At All Times
Power Distribution Cell 10
PCM/BCM Fuse 13 10 A
A
B
IP Fuse Block
C3
BRN 1040
BRN 1040
ORN 1040
ORN 1040
ORN 1040
ORN 1040
Power Inverter Module
Jump Start Block
GRY
Fusible Link 2140
GRY 2140
D101
ORN 940
ORN 940
D100
ORN 940
APS Output Comm
24
Accessory Power Control Module
WHT 2027
WHT 2027
WHT 2027
WHT 2027
Instrument Cluster Cell 81
Vehicle Wake Up
Paddle Present 12V
G
A
Charge Receptacle
WHT 2027
ORN 1040
E
C300
Battery
Vehicle Wake Up
Battery Pack Control Module
Drive Motor Battery Assembly
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR

264091

Circuit Description

When the Battery Pack Control Module is power-up a self system check is performed. The system check verifies that stored data values are the same at power-up as they were at the previous power down. The Battery Pack Control Module also verifies some hardware operations during this system check.

Conditions for Setting the DTC

- Checksum data stored in EEPROM at power-up does not equal EEPROM data stored at power-down.

Action Taken When the DTC Sets

- SERVICE NOW light will flash each time the Battery Pack Control Module attempts to reset.
- The SOC gauge will be inaccurate.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- When the fault conditions are no longer present The DTC will clear from current, and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- When this DTC is set Battery Pack Control Module data may not be accurate.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

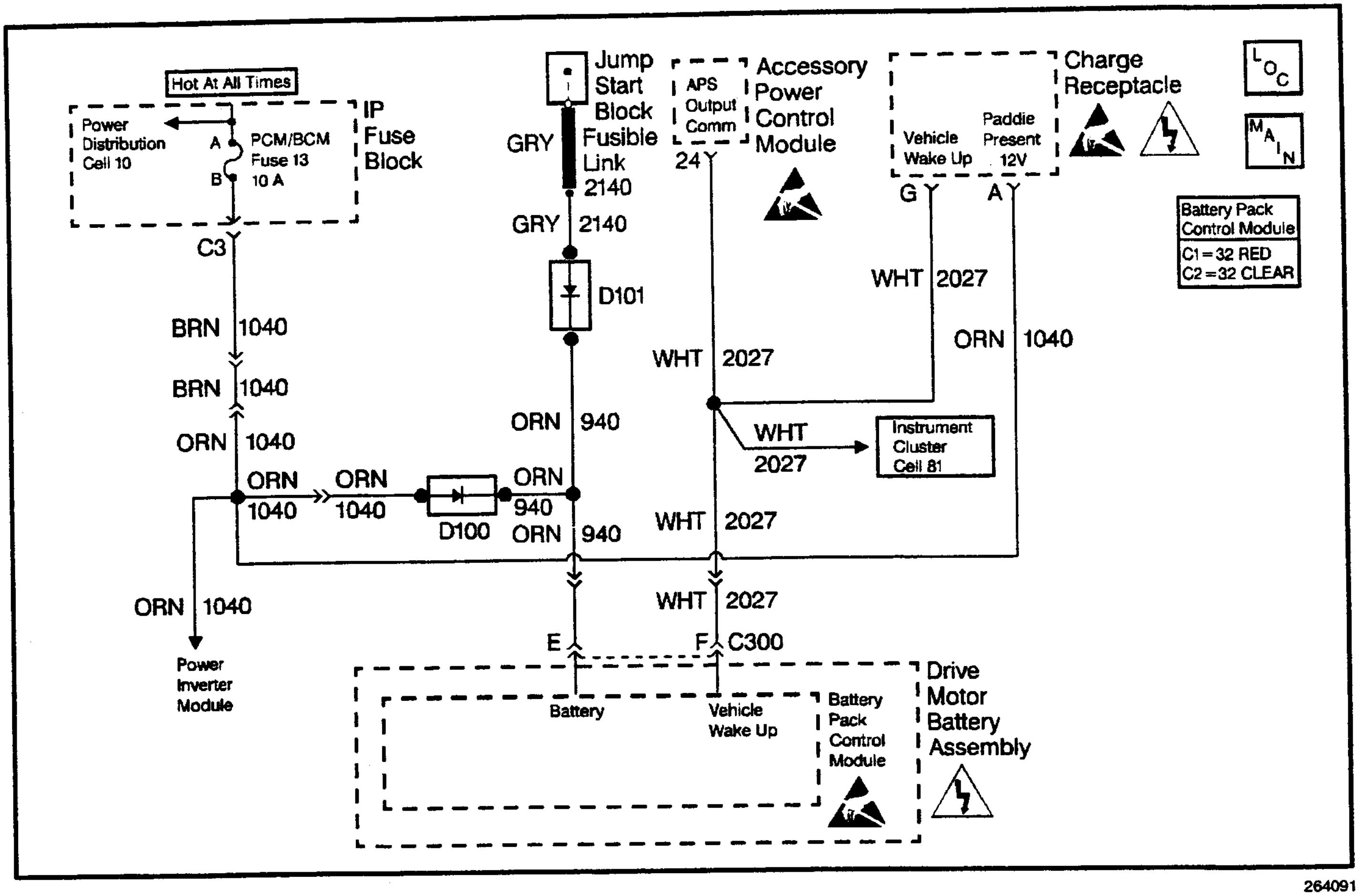
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the fault is present replace the Battery Pack Control Module.

DTC 303 Battery Pack Control Module Circuit

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault present?	—	Go to Step 3	Go to Diagnostic Aids
3	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 4	—
4	Clear DTC's. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 304 Battery Pack Control Module Keep Alive Memory


Hot At All Times
Power Distribution Cell 10
A
B
PCM/BCM Fuse 13 10 A
IP Fuse Block
C3
BRN 1040
BRN 1040
ORN 1040
ORN 1040
ORN 1040
ORN 1040
Power Inverter Module
Jump Start Block
GRY
Fusible Link 2140
GRY 2140
D101
ORN 940
ORN 940
D100
ORN 940
APS Output Comm
24
Accessory Power Control Module
WHT 2027
WHT 2027
Instrument Cluster Cell 81
WHT 2027
WHT 2027
Vehicle Wake Up
Paddle Present 12V
G
A
Charge Receptacle
WHT 2027
ORN 1040
E
F
C300
Battery
Vehicle Wake Up
Battery Pack Control Module
Drive Motor Battery Assembly
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
264091

Circuit Description

When the Battery Pack Control Module is power-up a self system check is performed. The system check verifies that stored data values are the same at power-up as they were at the previous power down. The Battery Pack Control Module also verifies some hardware operations during this system check.

Conditions for Setting the DTC

- Checksum data stored in Keep Alive Memory at power-up does not equal Keep Alive Memory data stored at power-down.
- Loss of battery feed on circuit 940 while the processor is asleep.

Action Taken When the DTC Sets

- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- When the fault conditions are no longer present The DTC will clear from current, and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

- If the processor looses 12 volt battery feed keep alive memory will be effected. Check circuit 940 for an intermittent condition before relating the Battery Pack Control Module.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

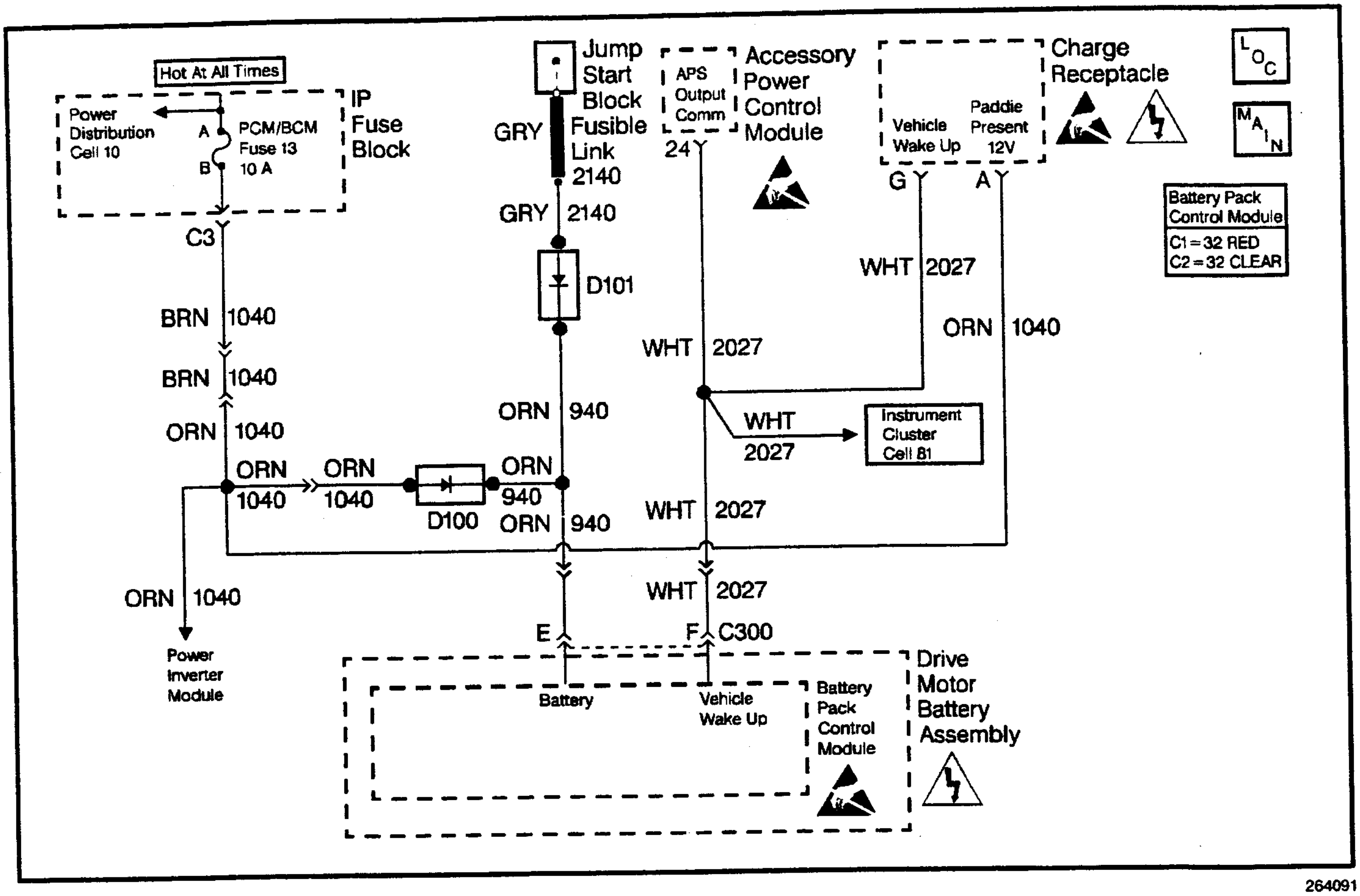
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the fault is present replace the Battery Pack Control Module.

DTC 304 Battery Pack Control Module Keep Alive Memory

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault present?	—	Go to Step 3	Go to Diagnostic Aids
3	Check for an intermittent open condition on the voltage feed circuit 940. Was a problem found on circuit 940?	—	Go to Step 4	Go to Step 5
4	Repair the open condition on circuit 940. Is the action complete?	—	Go to Step 6	—
5	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 305 Battery Pack Control Module Circuit


Hot At All Times
Power Distribution Cell 10
A
B
PCM/BCM Fuse 13 10 A
IP Fuse Block
C3
BRN 1040
BRN 1040
ORN 1040
ORN 1040
ORN 1040
ORN 1040
Power Inverter Module
Jump Start Block
GRY
Fusible Link 2140
GRY 2140
D101
ORN 940
ORN 940
D100
ORN 940
APS Output Comm
24
Accessory Power Control Module
WHT 2027
WHT 2027
WHT 2027
Instrument Cluster Cell 81
WHT 2027
WHT 2027
Vehicle Wake Up
Paddle Present 12V
G
A
Charge Receptacle
WHT 2027
ORN 1040
E
F
C300
Battery
Vehicle Wake Up
Battery Pack Control Module
Drive Motor Battery Assembly
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR

264091

Circuit Description

When the Battery Pack Control Module is power-up a self system check is performed. The system check verifies that stored data values are the same at power-up as they were at the previous power down. The Battery Pack Control Module also verifies some hardware operations during this system check.

Conditions for Setting the DTC

- At least one of the following Battery Pack Control Module DTC 306, 307, 308, 309 are set.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- When the fault conditions are no longer present The DTC will clear from current, and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

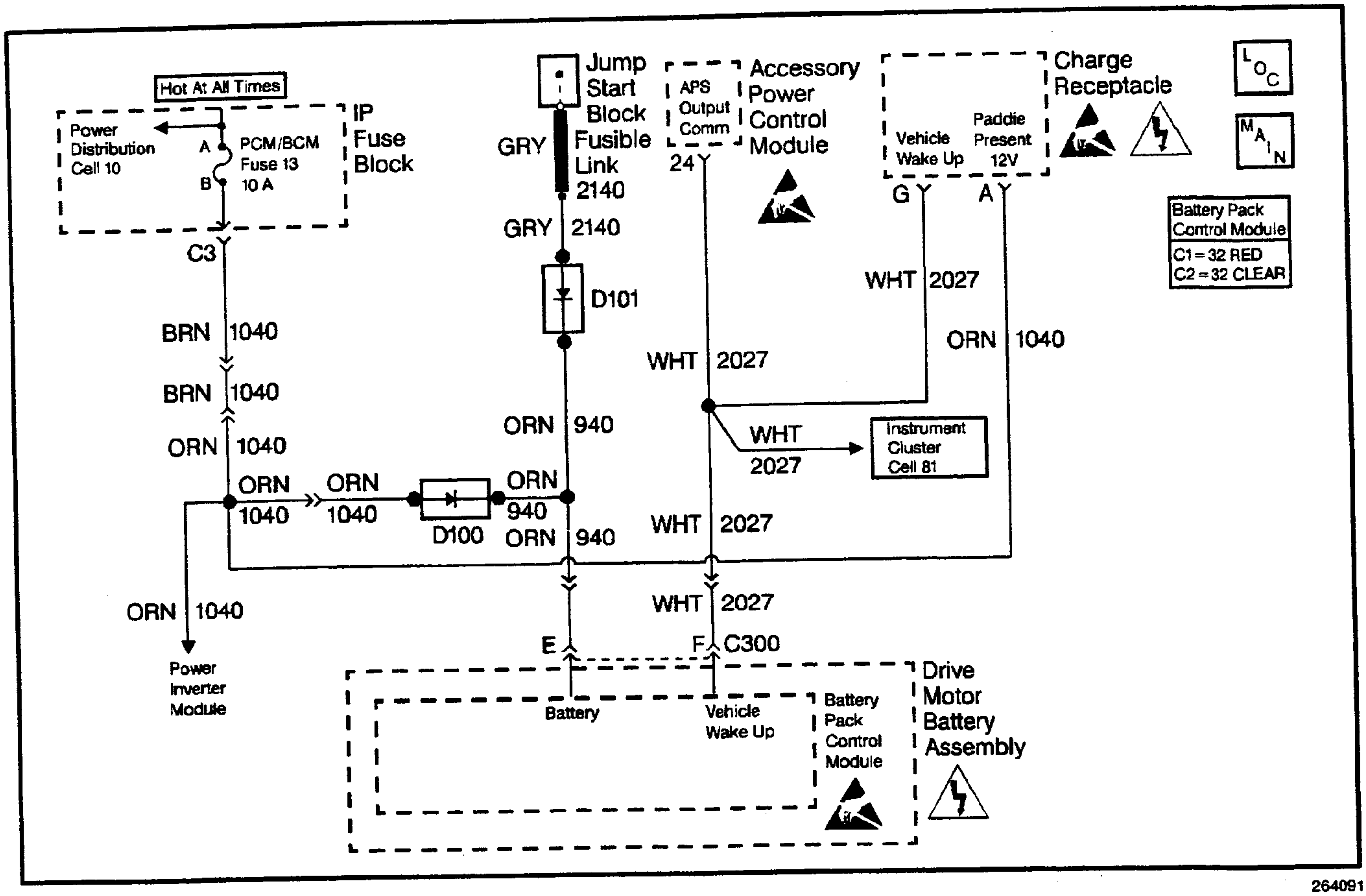
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Battery Pack Control Module DTC 306, 307, 308, or 312 will cause this DTC will set

DTC 305 Battery Pack Control Module Circuit

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Are DTCs 306, 307, 308, or 312 also set?	—	Go to other DTCs first.	Go to Step 3
3	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?		Go to Step 4	—
4	Clear DTC's. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 306 Battery Pack Control Module Circuit



Hot At All Times
Power Distribution Cell 10
A
B
PCM/BCM Fuse 13 10 A
IP Fuse Block
C3
BRN 1040
BRN 1040
ORN 1040
ORN 1040
ORN 1040
ORN 1040
Power Inverter Module
Jump Start Block
GRY
Fusible Link 2140
GRY 2140
D101
ORN 940
ORN 940
ORN 940
D100
APS Output Comm
Accessory Power Control Module
24
WHT 2027
WHT 2027
WHT 2027
WHT 2027
Instrument Cluster Cell 81
Charge Receptacle
Vehicle Wake Up
Paddle Present 12V
G
A
WHT 2027
ORN 1040
LOC
MAIN
Battery Pack Control Module
C1 = 32 RED
C2 = 32 CLEAR
E
F
C300
Battery
Vehicle Wake Up
Battery Pack Control Module
Drive Motor Battery Assembly

264091

Circuit Description

When the Battery Pack Control Module is power-up a self system check is performed. The system check verifies that stored data values are the same at power-up as they were at the previous power down. The Battery Pack Control Module also verifies some hardware operations during this system check.

Conditions for Setting the DTC

- The Battery Pack Control Module has detected a EEPROM fault.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Charging is disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- When the fault conditions are no longer present The DTC will clear from current, and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Check for the following conditions:

- Battery Pack Control Module DTC 105 should also be set.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

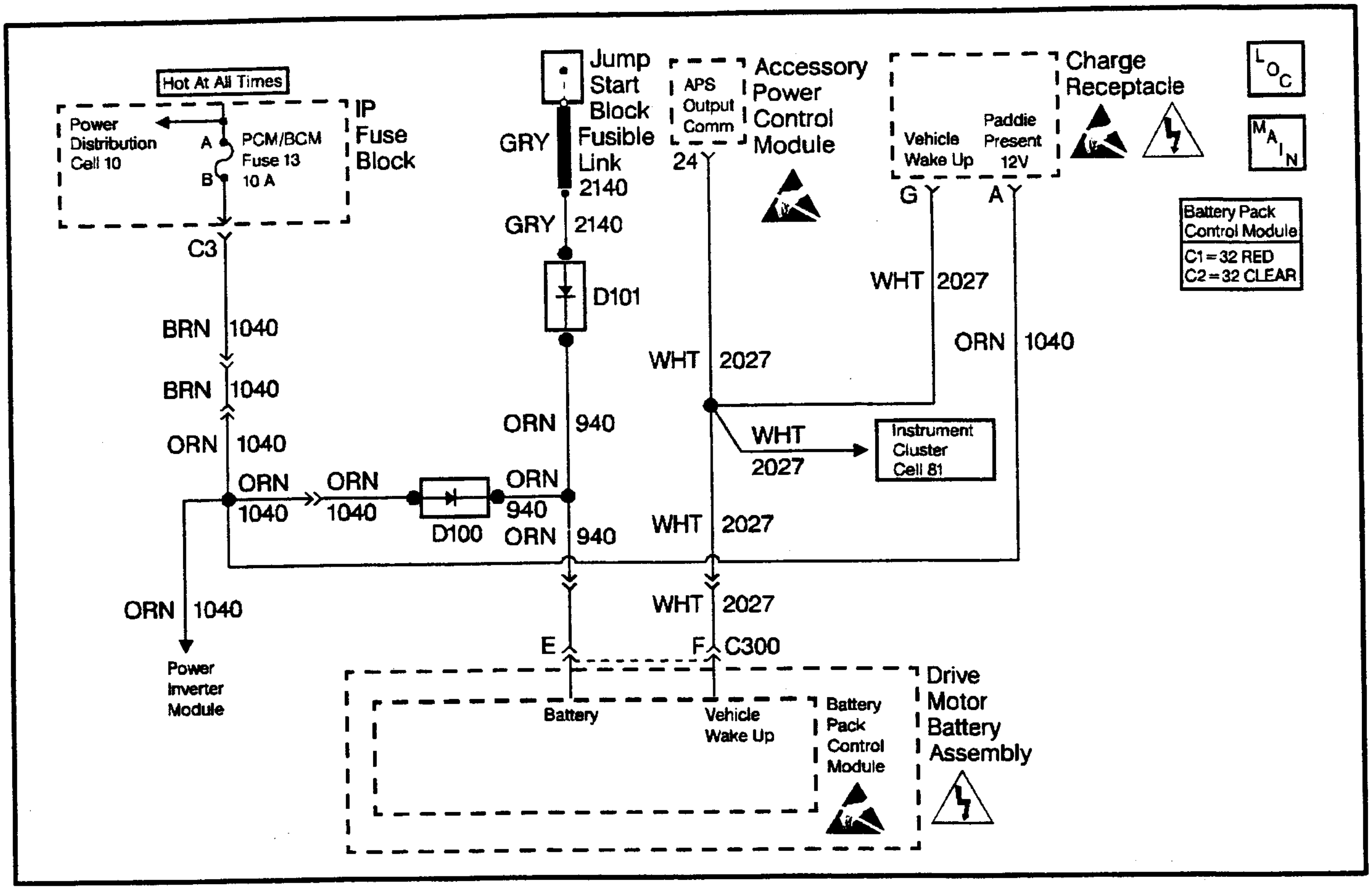
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the fault is present replace the Battery Pack Control Module.

DTC 306 Battery Pack Control Module Circuit

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault present?	—	Go to Step 3	Go to Diagnostic Aids
3	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 4	—
4	Clear DTC's. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 307 Battery Pack Control Module Circuit


Hot At All Times
Power Distribution Cell 10
A
B
PCM/BCM Fuse 13 10 A
IP Fuse Block
C3
BRN 1040
BRN 1040
ORN 1040
ORN 1040
ORN 1040
D100
ORN 940
ORN 940
ORN 940
ORN 1040
Power Inverter Module
Jump Start Block
GRY
Fusible Link 2140
GRY 2140
D101
APS Output Comm
24
Accessory Power Control Module
WHT 2027
WHT 2027
Instrument Cluster Cell 81
WHT 2027
WHT 2027
Charge Receptacle
Vehicle Wake Up
Paddle Present 12V
G
A
WHT 2027
ORN 1040
L O C
M A I N
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
E
F C300
Battery
Vehicle Wake Up
Battery Pack Control Module
Drive Motor Battery Assembly
264091

Circuit Description

When the Battery Pack Control Module is power-up a self system check is performed. The system check verifies that stored data values are the same at power-up as they were at the previous power down. The Battery Pack Control Module also verifies some hardware operations during this system check.

Conditions for Setting the DTC

- The Battery Pack Control Module has detected a RAM fault.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Charging is disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- When the fault conditions are no longer present The DTC will clear from current, and the vehicle will return to normal operation.
- The DTC will clear from history after 100 power cycles.
- DTC can be cleared by using the scan tool Clear Info function.

Diagnostic Aids

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the fault is present replace the Battery Pack Control Module.

DTC 307 Battery Pack Control Module Circuit

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault present?	—	Go to Step 3	Go to Diagnostic Aids
3	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 4	—
4	Clear DTC's. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 308 Battery Pack Control Module Circuit

Circuit Description

When the Battery Pack Control Module is power-up a self system check is performed. The system check verifies that stored data values are the same at power-up as they were at the previous power down. The Battery Pack Control Module also verifies some hardware operations during this system check.

Conditions for Setting the DTC

- The Battery Pack Control Module has detected a ROM fault.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Charging is disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after the fault is no longer present.
- The DTC will clear from history after 100 power cycles.

Diagnostic Aids

Check for the following conditions:

- If a new Battery Pack Control Module has been installed in the battery pack, and has not been flashed with the necessary software this DTC will set.
- If the DTC resets intermittently replace the Battery Pack Control Module.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks that the ROM fault is a hard failure.

DTC 308 Battery Pack Control Module Circuit

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault present?	—	Go to Step 3	Go to Diagnostic Aids
3	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 309 Battery Pack Reference Voltage Out of Range

Circuit Description

The Battery Pack Control Module contains a high precision power supply used to read the battery module voltages. The power supply has two levels, 0 volts and 10 volts.

Conditions for Setting the DTC

- One or both of the reference range voltages are out of range.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Charging is disabled.
- Battery module voltage readings are invalid.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after the fault is no longer present.
- The DTC will clear from history after 100 power cycles.

Diagnostic Aids

Check for the following conditions:

- This DTC is set due to an internal Battery Pack Control Module fault.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

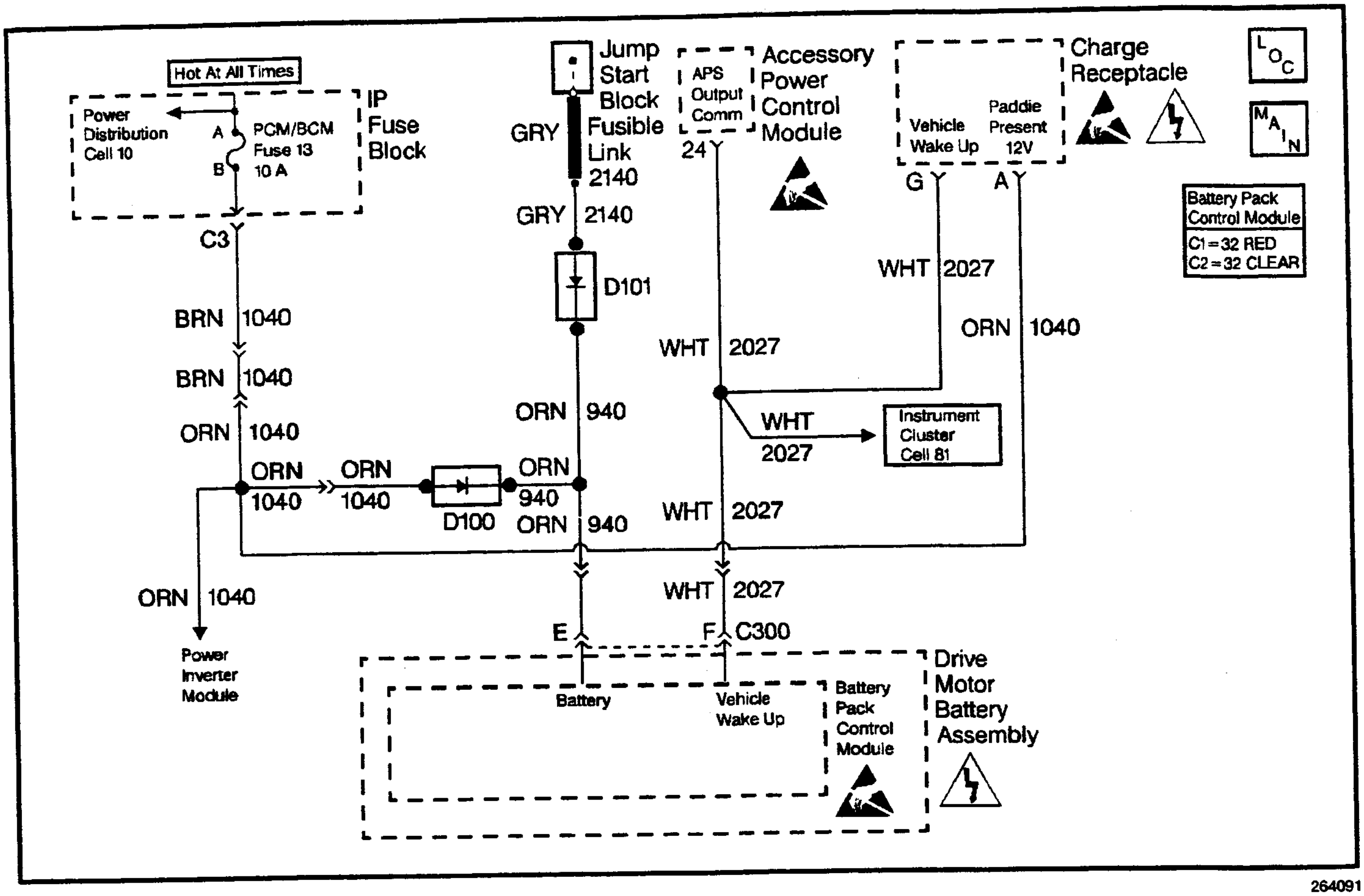
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. If the fault is present and the Battery Pack Control Module has been programmed, a new Battery Pack Control Module is needed.

DTC 309 Battery Pack Reference Voltage Out of Range

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the fault present?	—	Go to Step 3	Go to Diagnostic Aids
3	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 310 Accessory Voltage Circuit High


Hot At All Times
Power Distribution Cell 10
A
B
PCM/BCM Fuse 13 10 A
IP Fuse Block
C3
BRN 1040
BRN 1040
ORN 1040
ORN 1040
ORN 1040
ORN 1040
Power Inverter Module
Jump Start Block
GRY
Fusible Link 2140
GRY 2140
D101
ORN 940
ORN 940
D100
ORN 940
APS Output Comm
24
Accessory Power Control Module
WHT 2027
WHT 2027
Instrument Cluster Cell 81
WHT 2027
WHT 2027
E
F
C300
Charge Receptacle
Vehicle Wake Up
Paddle Present 12V
G
A
WHT 2027
ORN 1040
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
Battery
Vehicle Wake Up
Battery Pack Control Module
Drive Motor Battery Assembly

264091

Circuit Description

The Battery Pack Control Module contains two circuit boards, a high voltage board and a low voltage board. The Accessory Power Module and / or auxiliary battery supplies the accessory voltage, approximately 12V, to the Battery Pack Control Module. When Accessory Power Module is off, the voltage is fed directly from the auxiliary battery. If the accessory voltage range is above 16 volts, the high voltage board will shut down.

Conditions for Setting the DTC

- Accessory voltage is greater than 16 volts.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Charging is disabled.
- The Battery Pack Control Module will shut down the high voltage board.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after the fault is no longer present.
- The DTC will clear from history after 100 power cycles.

Diagnostic Aids

Check for the following conditions:

- When this fault occurs the module voltages and pack voltages will reflect the last valid reading before the Battery Pack Control Module shuts down the high voltage board.
- This DTC may be set if the auxiliary battery is being charged by a high powered battery charger. If the auxiliary battery is in need of charging remove the positive and negative battery cables from the battery before recharging.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

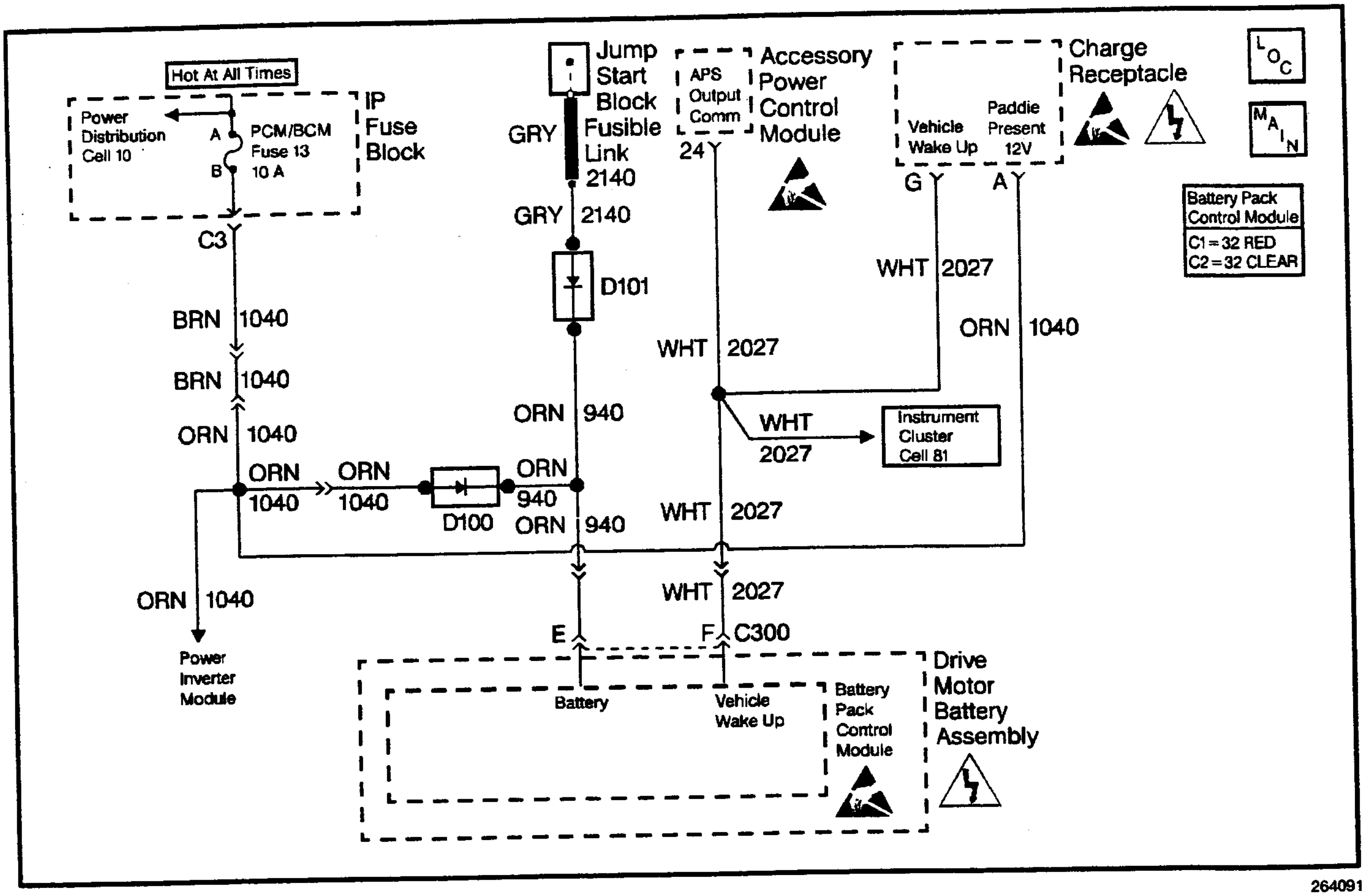
Number(s) below refer to the step number(s) on the Diagnostic Table.

2. Checks for proper aux battery voltage.
3. Checks Accessory Power Control Module supplied voltage.
4. Looks for voltage supply from the battery pack.

DTC 310 Accessory Voltage Circuit High

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is the DTC current?	—	Go to Step 3	Go to Diagnostic Aids
3	***Notice:*** Performing the following procedures will result in one or more Battery Pack Control Module DTC(s) being set. 1. Turn the ignition OFF. 2. Connect the Battery pack breakout box J 42494 to the 20 way connector. 3. Open switch E and check voltage on the harness side of the breakout box. Was the voltage within the specified value?	11 - 13 volts	Go to Step 4	Go to Step 7
4	1. With the Battery Pack Breakout box still connected and switch E open turn the ignition ON. 2. Wait 60 seconds. 3. Check voltage on the harness side of pin E on the breakout box. Was the voltage within the specified value?	13 - 15 volts	Go to Step 5	Go to Step 6
5	1. Close the switch E on the Battery Pack Breakout box. 2. With the ignition ON Check voltage on the harness side of pin E on the breakout box. Was the voltage within the specified value?	Less than 16 volts	Go to Diagnostic Aids	Go to Step 8
6	Replace the Accessory Power Control Module. Refer to *Accessory Power Control Module removal and installation.*	—	Go to Step 9	—
7	Auxiliary battery voltage out of range. Refer to *Section Auxiliary Battery.* Is the action complete?	—	Go to Step 9	—
8	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 9	—
9	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 311 Accessory Voltage Circuit Low


Hot At All Times
Power Distribution Cell 10
PCM/BCM Fuse 13 10 A
IP Fuse Block
A
B
C3
BRN 1040
ORN 1040
ORN 1040
Power Inverter Module
Jump Start Block
GRY
Fusible Link 2140
GRY 2140
D101
ORN 940
D100
E
F
C300
APS Output Comm
Accessory Power Control Module
24
WHT 2027
Instrument Cluster Cell 81
Vehicle Wake Up
Paddle Present 12V
Charge Receptacle
G
A
ORN 1040
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR
Battery
Vehicle Wake Up
Battery Pack Control Module
Drive Motor Battery Assembly
264091

Circuit Description

The Battery Pack Control Module contains two circuit boards, a high voltage board and a low voltage board. The Accessory Power Module and / or auxiliary battery supplies the accessory voltage, approximately 12V, to the Battery Pack Control Module. When Accessory Power Module is off, the voltage is fed directly from the auxiliary battery. If the accessory voltage range drops below 8.7 volts the high voltage board will shut down.

Conditions for Setting the DTC

- The accessory voltage is less than 8.7 volts ± 0.75 volts.
- The accessory voltage is greater than 4.5 volts.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- HTCM will not allow HVAC function.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after the fault is no longer present.
- The DTC will clear from history after 100 power cycles.

Diagnostic Aids

Check for the following conditions:

- When this fault occurs the module voltages and pack voltages will reflect the last valid reading before the Battery Pack Control Module shuts down the high voltage board.
- Loose or damaged 20 way connector to the Battery Pack Control Module.
- Pinched or damaged wire in the 12 volt supply circuit to the Battery Pack Control Module.
- If Drive Motor Control Module DTC 104 is not set with this DTC, the problem is in the power feed to the Battery Pack Control Module.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

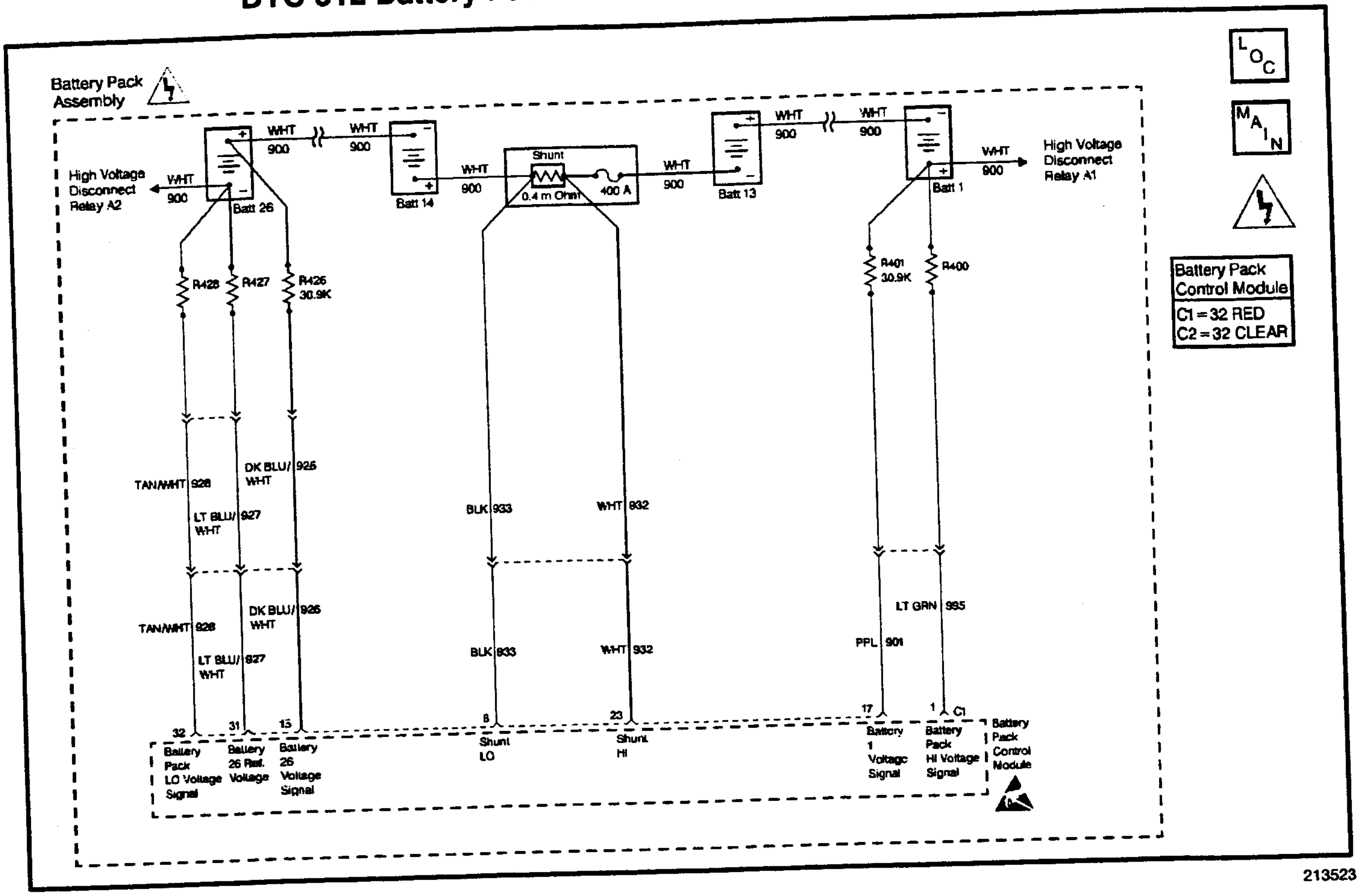
Number(s) below refer to the step number(s) on the Diagnostic Table.

3. Checks for proper aux battery voltage.

DTC 311 Accessory Voltage Circuit Low

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	Is Drive Motor Control Module DTC 104 or 059 also set?	—	Go to other DTC first	Go to Step 3
3	***Notice:*** Performing the following procedures will result in one or more Battery Pack Control Module DTC(s) being set. 1. Turn the ignition OFF. 2. Connect the Battery pack breakout box J 42494 to the 20 way connector. 3. Open switch E and check voltage on the harness side of the breakout box using a DMM. Was the voltage within the specified value?	11-14 volts	Go to Step 4	Go to Step 5
4	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 6	—
5	Repair open or short to ground on the 12 volt supply wire to the Battery Pack Control Module. Refer to *electrical diagnosis.*	—	Go to Step 6	—
6	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

DTC 312 Battery Pack Control Module Circuit Voltage High


Battery Pack Assembly
High Voltage Disconnect Relay A2
WHT 900
Batt 26
Batt 14
Shunt
0.4 m Ohm
400 A
Batt 13
Batt 1
High Voltage Disconnect Relay A1
R428
R427
R426 30.9K
R401 30.9K
R400
TAN/WHT 928
LT BLU/WHT 927
DK BLU/WHT 926
BLK 933
WHT 932
PPL 901
LT GRN 995
32
31
15
8
23
17
1
C1
Battery Pack LO Voltage Signal
Battery 26 Ref. Voltage
Battery 26 Voltage Signal
Shunt LO
Shunt HI
Battery 1 Voltage Signal
Battery Pack HI Voltage Signal
Battery Pack Control Module
LOC
MAIN
Battery Pack Control Module
C1=32 RED
C2=32 CLEAR

213523

Circuit Description

The total potential voltage from the battery pack is split into positive and negative voltage. On a fully charged battery pack, the positive side should have approximately 160 positive volts and the negative side should have approximately 160 negative volts. These two voltage potentials combined create the 320 volt total pack voltage potential. The positive and negative voltage potential is monitored by reading the Pack_HI and Pack_LO voltage referenced to the shunt. As battery power is reduced through normal driving, each side of the battery pack voltage should reduce equally. In the event that the positive voltage becomes less then negative voltage a DTC will set.

Conditions for Setting the DTC

- Battery Pack Control Module detects an voltage imbalance between the positive and negative potentials in the battery pack.

Action Taken When the DTC Sets

- Battery Pack Control Module will request the Drive Motor Control Module to illuminate the SERVICE SOON light.
- Charging is disabled.
- Propulsion is disabled.
- DTC will be stored in failure records buffer.

Conditions for Clearing the DTC

- DTC can be cleared by using the scan tool Clear Info function after the fault is no longer present.
- The DTC will clear from history after 100 power cycles.

Diagnostic Aids

- If this DTC sets intermittently, one or more battery modules may have loose connections or sense leads and pack service may be required.

Reviewing the Failure records since the diagnostic test last failed may help determine how often the condition that caused the DTC to be set occurs. This may assist in diagnosing the condition.

Test Description

Number(s) below refer to the step number(s) on the Diagnostic Table.

2. This DTC should set with other Battery Pack Control Module DTC(s).

DTC 312 Battery Pack Control Module Circuit Voltage High

Step	Action	Value(s)	Yes	No
1	Was the on board Diagnostic System Check performed?	—	Go to Step 2	Go to *OBD System Check*
2	1. Turn the ignition OFF. 2. Allow the system to power down. 3. Turn the ignition ON. 4. Using a scan tool check for current DTC(s). Are any other Battery Pack Control Module DTC(s) set?	—	Go to Other DTC(s) First	Go to Step 3
3	Repair the Battery Pack. Refer to *Battery Pack Internal Service Manual.* Is the action complete?	—	Go to Step 4	—
4	Clear DTCs. Refer To *Clearing Diagnostic Trouble Codes.* Is the action complete?	—	Go to OBD systems check	—

Important Preliminary Checks

Checks	Action
Before Using This Section	Before using this section you should have performed the On-Board Diagnostic (OBD) System Check and determined that: 1. Both the Drive Motor and Battery Pack Control Modules as well as their related Malfunction Indicator Lamp(s) (MILs) are operating correctly. 2. There are no Diagnostic Trouble Codes (DTCs) stored, or there is a diagnostic code but no MIL. 3. Several of the following symptom procedures call for a careful visual/physical check. The importance of visual/physical checks cannot be over stressed, because they can lead to correcting a problem without further checks and can save valuable time.
Before Starting	Check the bolt control modules grounds for being clean, tight, and in their proper locations. Refer to *Drive Motor Control Module or Battery Pack Control Module Wiring Diagrams.* • Check the wiring for proper connections, pinches, and cuts. Refer to *Wiring Diagrams.* • The following symptom tables contain groups of possible causes for each symptom. These procedures do not have to be done in consecutive order. If the scan tool readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely cause first. To determine if a specific vehicle is using a particular system or component, refer to the *Wiring Diagrams* for application.
Symptom	Verify the customer complaint, and locate the correct symptom in the table of contents. Check the items indicated under that symptom.

Intermittents

Checks	Action
DEFINITION: The problem may or may not turn ON the Malfunction Indicator Lamp(s) (MIL) or store a Diagnostic Trouble Code (DTC).	
Preliminary Checks	• Refer to *Important Preliminary Checks.* • **Do Not** use the DTC tables in this section for intermittent problems. The fault must be present to locate the problem. If a fault is intermittent, the use of DTC tables may result in the replacement of good parts.
Faulty Electrical Connections or Wiring	Faulty electrical connections or wiring can cause most intermittent problems. Perform a careful check of the suspected circuit for the following: • Poor mating of the connector halves, or terminals, not fully seated in the connector body (backed out). • Improperly formed or damaged terminals, carefully reform or replace all the connector terminals in the problem circuit to insure the proper contact tension. • Poor terminal to wire connection, this requires removing the terminal from the connector body to check. Refer to *Electrical Diagnosis.*
Road Test	If a visual/physical check does not locate the cause of the problem, drive the vehicle with a voltmeter connected to a suspected circuit or use a scan tool. If the wiring and connectors check OK, and a DTC was stored for a circuit having a sensor, replace the sensor.

Intermittents (continued)

Checks	Action
DEFINITION: The problem may or may not turn ON the Malfunction Indicator Lamp(s) (MIL) or store a Diagnostic Trouble Code (DTC).	
Intermittent Malfunction Indicator Lamp (MIL)	The following can cause an intermittent MIL and no DTCs: • Electrical system interference caused by a defective relay, Control Module driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operating. • The improper installation of electrical devices, such as lights, 2-way radios, electric motors, etc.. • The Malfunction Indicator Lamp (MIL) circuit or the diagnostic test terminal intermittently shorted to ground. • The Control Module grounds. Refer to *Component Locations, .*
Loss of DTC Memory	To check, disconnect the Accelerator Pedal Position (APP) sensor and turn the ignition to run. The Malfunction Indicator Lamp should come ON. A DTC should store and remain in memory when turning OFF the ignition for at least 10 seconds. If not, the Control Module may be faulty.

Lack Of Power

Checks	Action
DEFINITION: The Drive Motor delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	• Refer to *Important Preliminary Checks.* • Check for DTC(s) that place the vehicle into a reduced performance mode. • Be sure to check the drive motor speed and direction sensor for proper connection and function. It is possible for the vehicle to enter a reduced performance condition with no diagnostic trouble codes if the drive motor speed and direction sensor is disconnected or faulty. • Compare the customers vehicle with a similar unit. Make sure the customer has an actual problem.
Additional Checks	• Check the Control Module grounds for being clean, tight, and in their proper location. • Check for dragging brakes. Refer to the appropriate service manual section. • Check the Service Bulletins for updates.

Vehicle Will Not Charge

Checks	Action
DEFINITION: Battery Pack does not charge When the vehicle is connected to the Drive Motor Battery charger.	
Preliminary Check	Refer to *Important Preliminary Checks.*
Additional Checks	• Check the Service Bulletins for updates. • Inspect charge receptacle for damage. • Try another charging station. • Turn the key OFF and allow the data bus to shut down. Then place the charge paddle into the charge receptacle. If the data bus has a high amount of traffic it is possible for the charger to have trouble communicating with the vehicle. Turning OFF the ignition will allow the charger to communicate with the Battery Pack Control Module more easily. • If the battery pack has been highly discharged the high voltage relays may not close. This condition will prevent the vehicle from being charged. Remove the battery pack and charge the battery modules individually and try to charge the pack as an assembly.

Vehicle Will Not Complete a Charge

Checks	Action
DEFINITION: Battery Pack Charger does not read (FULL/ COMPLETE) after charging the battery pack for over 8 hours.	
Preliminary Check	Refer to *Important Preliminary Checks.* • Insure that the vehicle does not have any DTC(s) that will increase charge times such as pack over temperature. • Use the scan tool to check the current level being supplied during charge. If the current level is low (2 amps or less) check module voltages for a 1 volt or greater difference. If some module voltages are more than 1 volt from the pack average Internal service may be required.
Additional Checks	• Check the Service Bulletins for updates. • Try another charging station.

Vehicle Will Not Power Up

Checks	Action
DEFINITION: Ignition switch in the run position. Vehicle electrical accessories working properly, no high voltage indicated, and no propulsion.	
Preliminary Checks	• Refer to *Important Preliminary Checks..* • Check the following: - Check the Run 2 relay and circuit for an open. - Check for 12 volts at the auxiliary battery. - Check for a faulty ignition switch. - Check for loose, missing, or damaged auxiliary battery cables or grounds. - Check for 12 volts at PIN 20 of the Inverter Module 32-way connector.
Additional Checks	• Check for any DTCs relating to the high voltage system. Refer to the appropriate service manual section. • Check the Service Bulletins for updates. • If the vehicle will not precharge the Power Inverter Module check for shorted high voltage components with the digital isolation tester.

Vehicle Will Not Power Down

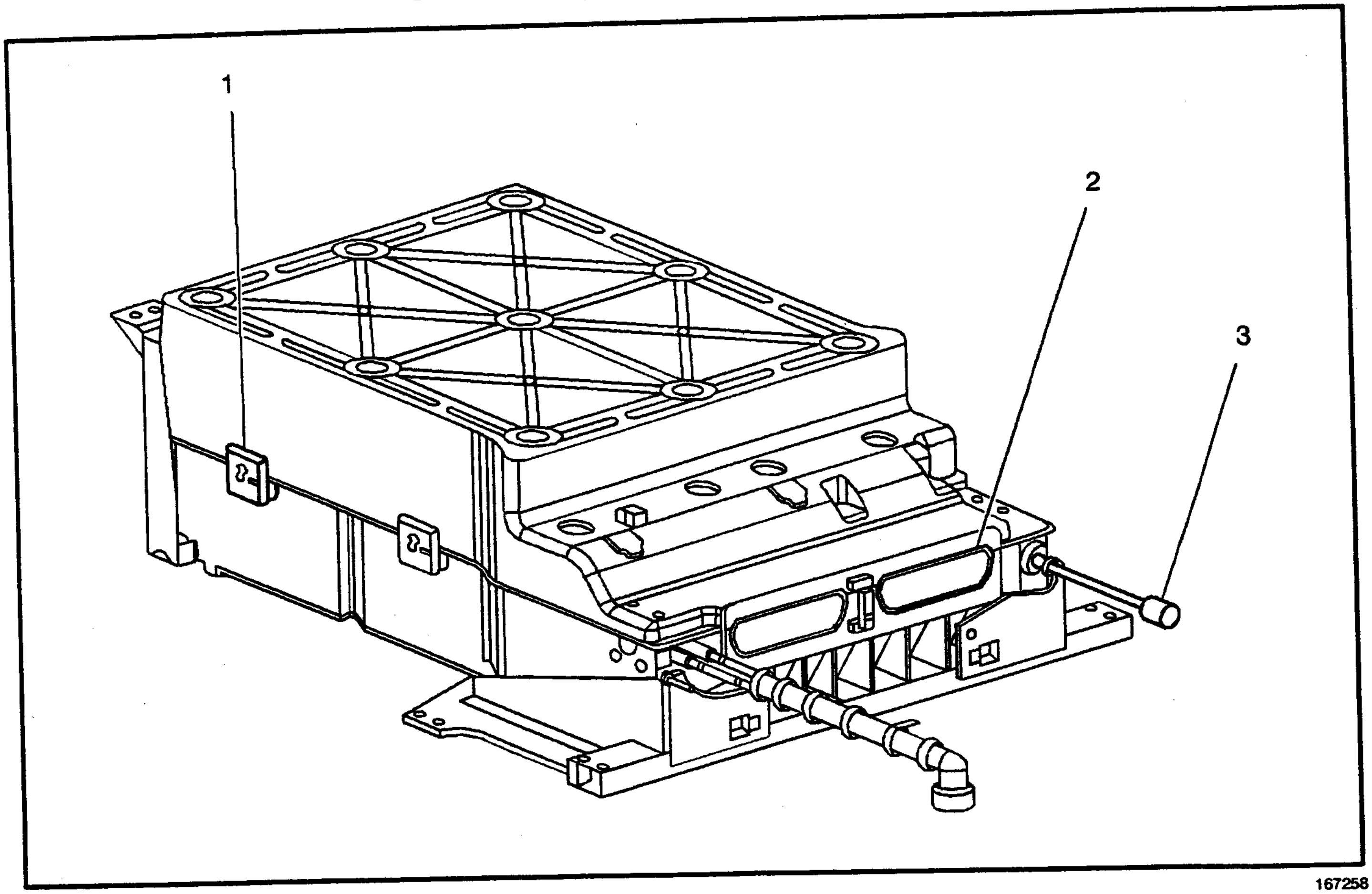
Checks	Action
DEFINITION: Ignition switch in the OFF position. All vehicle electrical accessories OFF. Auxiliary battery fully charged. No battery pack thermal activity. Vehicle wake-up is on for longer then 60 minutes.	
Preliminary Checks	- Refer to *Important Preliminary Checks* • Short to 12 volts on the vehicle wake-up circuit. • Check for a parasitic drain on the Aux battery.
Additional Checks	• Check for any DTCs relating to the high voltage system. Refer to the appropriate service manual section. • Check the Service Bulletins for updates.

Reduced Range

Checks	Action
DEFINITION: Vehicle range, as measured by an actual road test, is noticeably lower than expected. Also, the vehicle range is noticeably lower than it was on this vehicle at one time, as previously shown by an actual road test. Temperature should also be taken into consideration when looking at inconsistent range.	
Preliminary Checks	• Refer to *Important Preliminary Checks.* • Check owners driving habits: - Is the A/C ON full time (Defroster mode ON)? - Check the tires for being at the correct pressure? - Are exceedingly heavy loads being carried? - Are steep grades frequently being driven? - Is the acceleration too much, too often? • Check for alterations to the vehicle that may increase wind drag: - Provided tannoue cover not in use. - Addition of hood bug deflector. • Cold climate conditions increasing rolling resistance and decreasing battery temperature. Expect range to decrease when the vehicle is being operated in cold climates. • It is very important for the battery pack to complete charging sequences, especially during the equalizing portion where charging current is reduced and the battery module voltages are all equalized. Failure to allow the vehicle to equalize periodically, will eventually result in pack capacity loss and battery performance loss.
Additional Checks	• Check for the proper calibration of speedometer. • Check for dragging brakes. Refer to the appropriate service manual section. • Check the Service Bulletins for updates. • If a low battery pack capacity is suspected run a Battery Pack Discharge Test. The Battery Pack Discharge Test will discharge the pack at a steady 25 amps until 38.4 amp hours has been removed. Any batteries that can not supply 38.4 amp hours without falling into code setting conditions should be replaced.

Repair Instructions

S10 Electric, Lead-Acid Battery Pack



Legend
1. Locking Cams
2. Duct Assembly
3. 20-Way In line Harness

Introduction

This manual contains service procedures for the S10 Electric, Lead-Acid Battery Pack. Service Procedures include information for preliminary safety checks, disassembly, parts repair or replacement, assembly and post assembly check of the battery pack. Procedures are given for disassembly, repair or replacement, and assembly of the battery pack which may not be necessary in all cases. The extent of maintenance required will be determined, in a large part, by the Diagnostic Trouble Code (DTC) received from the battery pack control module (BPCM) (See "As Removed" Diagnostic Trouble Code).

The exploded view illustrations make it possible to view the complete assembly and major subassemblies in addition to the service procedure illustrations.

General Description

The S10 Electric, Lead-Acid Battery Pack is a complete system that includes batteries, battery retention hardware, electrical cabling and connections, safety devices and a control module. All system elements are designed and fabricated to work together as a unit. Twenty-six 12-volt, valve-regulated, lead-acid, high-density, deep-cycle batteries are connected in series to provide a nominal output of 312 VDC. Safety devices include an automatic disconnect (AD) and a "daisy chain" wiring pattern that breaks the circuit if any high voltage connection is severed. The battery pack control module (BPCM) is a computer that senses voltage and temperature of the batteries and controls charging. The module also detects and stores diagnostic information in the form of diagnostic trouble codes (DTC).

Battery Pack Condition

As it is removed from the vehicle for service, the battery pack will be installed on a special metal support, Battery pack tray support J42500 (Refer to *Figure 1-3*). The battery pack should remain on this support during preliminary and safety checks, disassembly, repair, assembly and final assembly checks. After all service, the battery pack should remain on the support for vehicle installation or shipment.

Diagnostic Trouble Codes

Diagnostic trouble codes (DTC), from the on board diagnostic (OBD) system are an output from the battery pack control module (BPCM). This information must be reviewed before the battery pack is removed from the vehicle. (Notice: This memory is lost when the battery pack is disconnected from the vehicle) This information, along with visual inspection and the operating time accumulated by the battery pack, determines the extent of maintenance required.

Safety Precautions

CAUTION: Fully charged, the assembled battery pack has a total voltage of at least 312 VDC. Be sure to follow all safety precautions specified in this manual as well as all standard shop safety precautions normally followed when servicing high voltage equipment.

High Voltage Disable Procedure

The High Voltage Disable Procedure should be completed when working on or around any high voltage and before any of the procedures in this section are performed.

Battery Pack Control Module Reprogramming

Some vehicles allow reprogramming of the control module without removal from the vehicle. This provides a flexible and a cost-effective method of making changes in software and calibrations. Software Programming is done using a scan tool.

Reprogramming the Battery Pack Control Module will effect the learned state of charge value that is shared with the Drive Motor Control Module and the state of charge gauge on the dash. In order for the Battery Pack Control Module to relearn the SOC the key should be cycled twice immediately after reflashing then the battery pack must be charged to completion.

The Service Programming System (SPS) will not allow incorrect software programming or incorrect calibration changes. For instruction and information on this procedure, Refer to the latest Techline information on re-programming or flashing procedures.

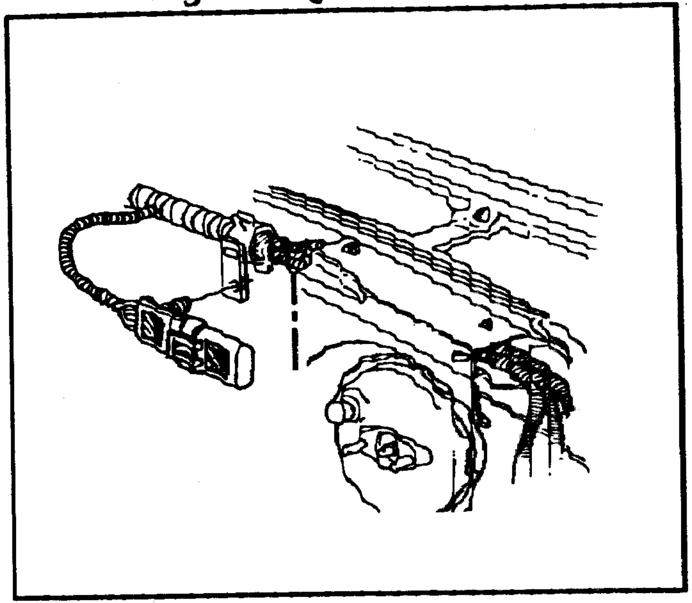
Battery Pack Assembly

Caution: To reduce the risk of severe shocks and burns, the High Voltage System should be disabled any time service work is being performed on or around the High Voltage System. The 12-volt system will still be active after the High Voltage System has been disabled

Caution: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle on the opposite end from which components are being removed. This will reduce the possibility of the vehicle falling off the hoist.

Remove or Disconnect

High Voltage Disconnect



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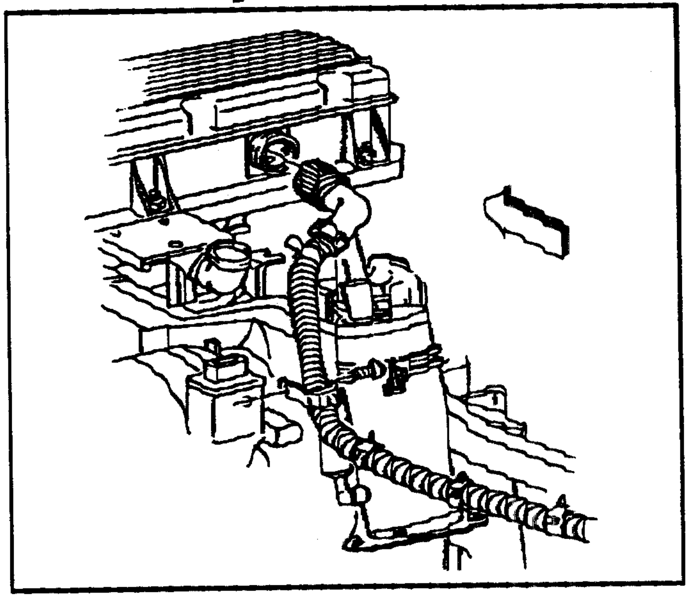
1. Remove the high voltage disconnect.

Battery Pack Power Cable



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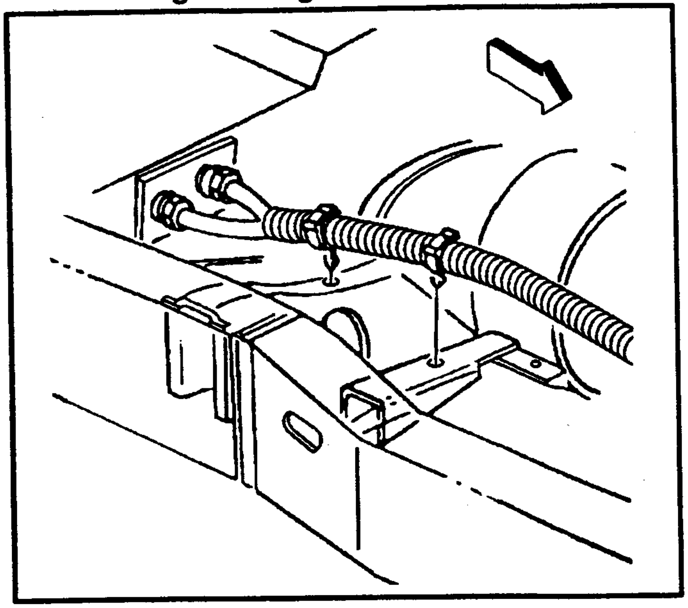
2. Disconnect the battery pack high voltage cable from drive motor inverter module.
3. Raise vehicle on hoist.
4. Strap vehicle to hoist.
5. Skid plate. Refer to *Skid Plate Removal*.
6. Disconnect the air duct manifold from battery pack.

High Voltage Cable Straps



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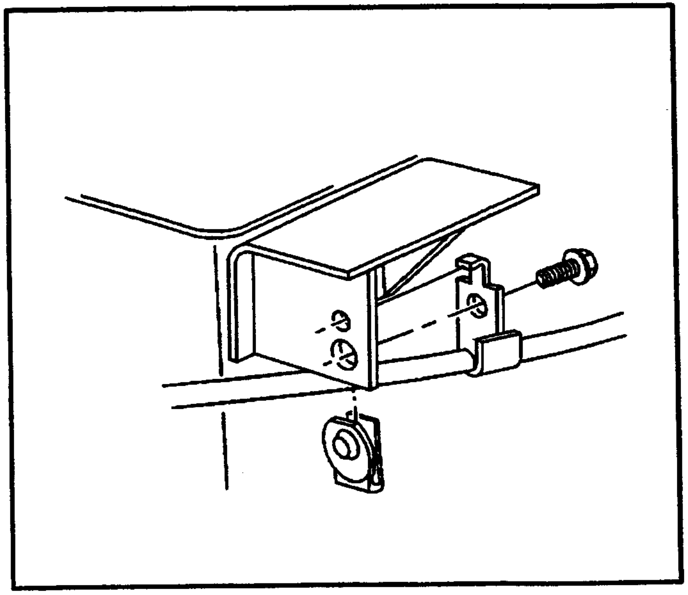
7. Remove the battery pack high voltage cable from cable straps along frame and body.
8. Disconnect the 20-way battery pack harness at front left of battery pack.

Brake Cable Mounting



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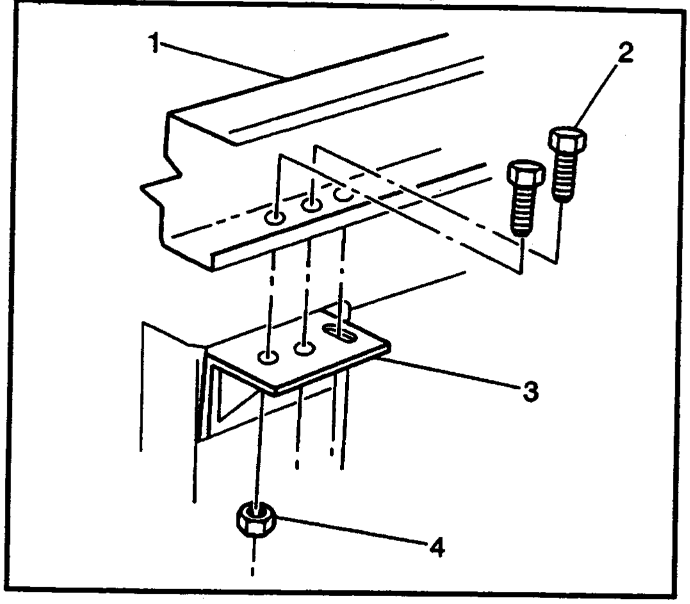
9. Remove the emergency brake cable mounting bolt at left rear of the battery pack.
10. Position the J 42187 Battery Pack Lift with pallet under the battery pack.
11. Raise the battery pack lift until pallet contacts bottom of battery pack.

Battery Pack Mounting Bolts Rear



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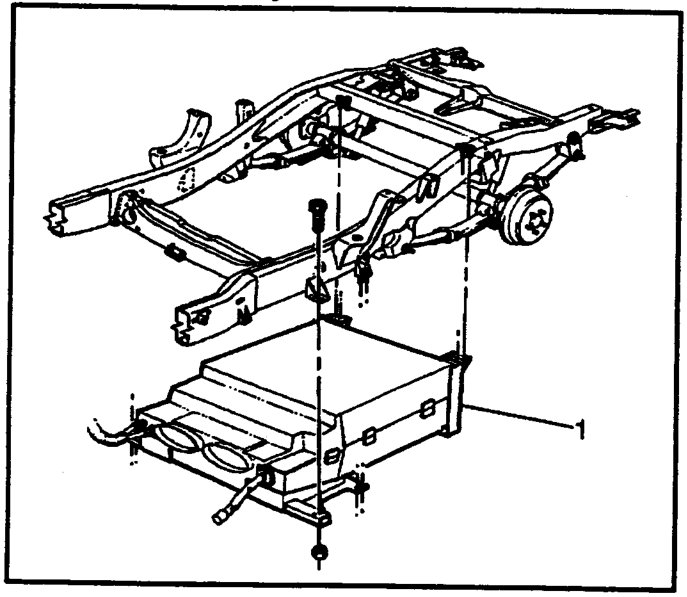
12. Remove the ten bolts and nuts securing battery pack to vehicle frame.

Battery Pack Removal



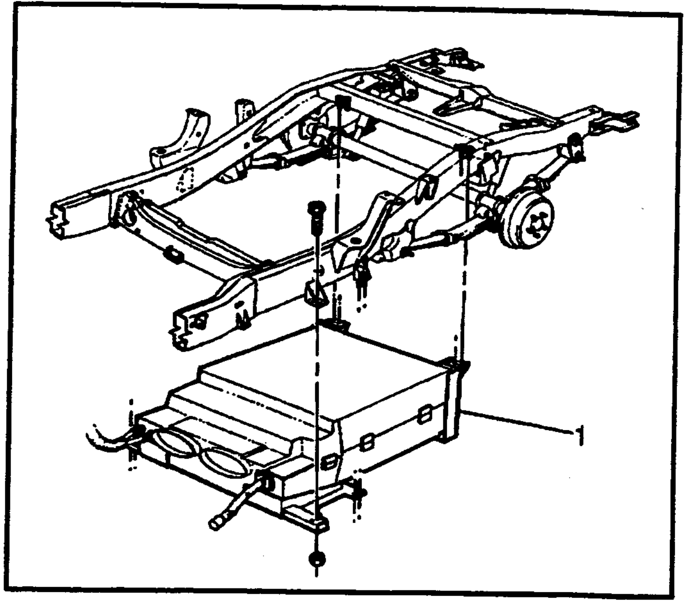
25030

13. Lower the battery pack lift to remove the battery pack.

Install or Connect

1. Position the battery pack lift with battery pack under vehicle.
2. Raise the battery pack lift until mounting brackets on rear of battery pack are past and clear of rear axle.

Battery Pack Installation



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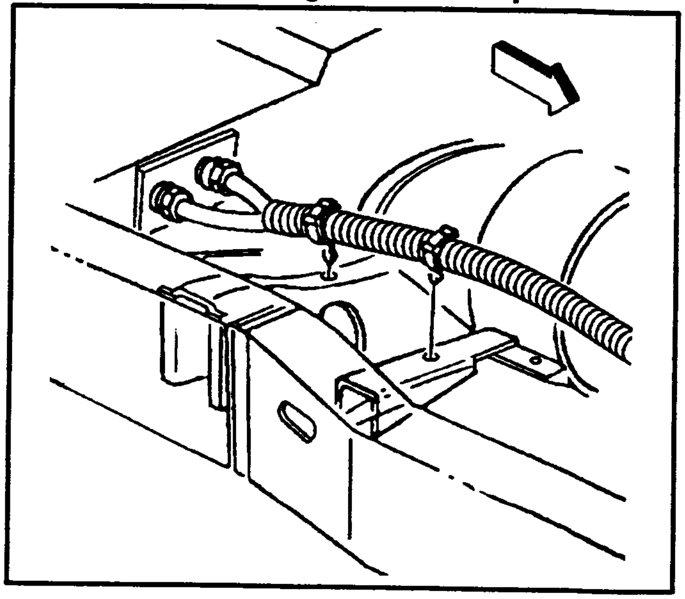
3. Move the battery pack lift to the rear until mounting brackets on rear of battery pack are aligned with holes in frame.
4. Feed the battery pack high voltage cable up and over the torsion bar frame crossmember.
5. Raise the battery pack lift so that pack contacts frame mounting brackets.
6. Install all ten battery pack mounting bolts and nuts.
7. Tighten Nuts to 75 N•m (55.3 lb ft)

High Voltage Cable Straps



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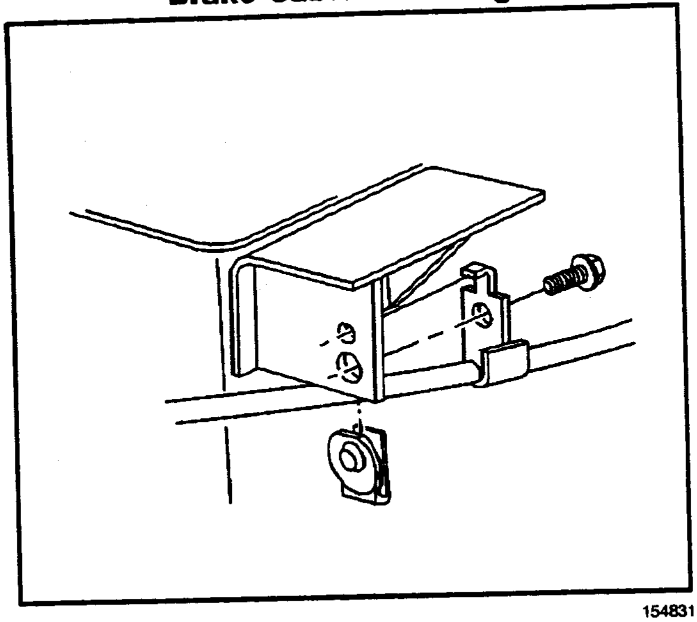
8. Install the battery pack high voltage cable to cable straps.
9. Install the air Duct manifold to battery pack.

Brake Cable Mounting



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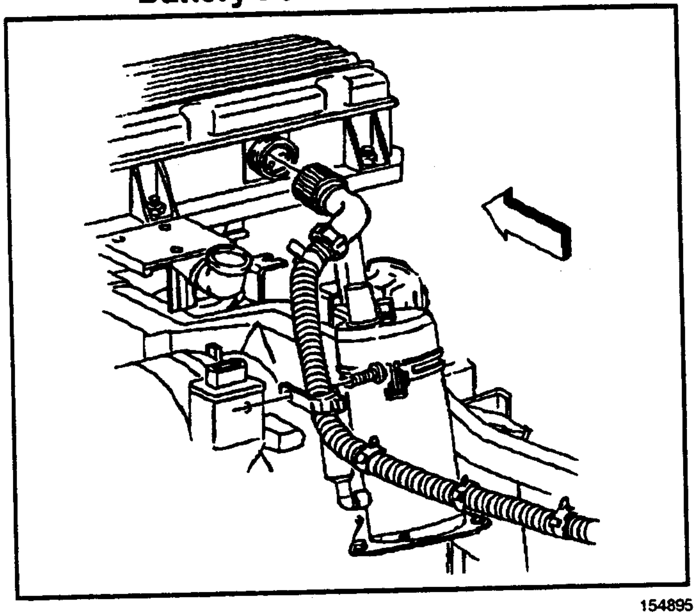
10. Install the emergency brake cable mounting bolt at left rear of the battery pack. Tighten to 25 N•m (18 lb ft)
11. Install skid plate. Refer to *Skid Plate Installation.*
12. Lower vehicle on hoist.

Battery Pack Power Cable



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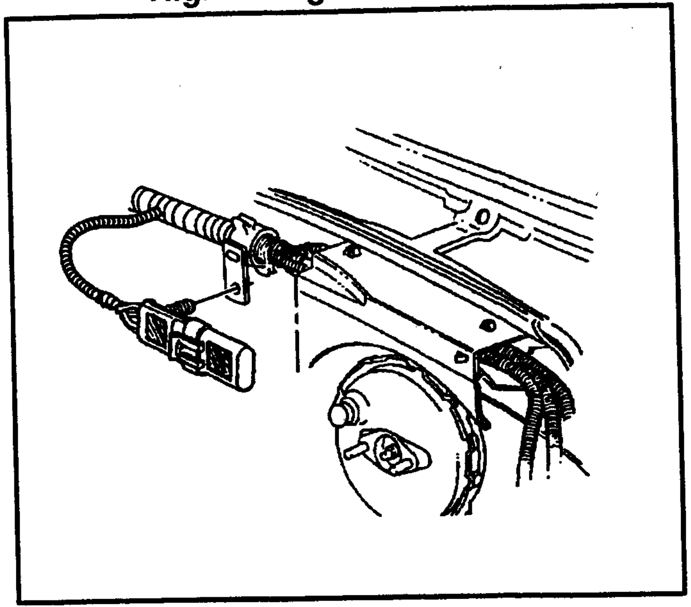
13. Connect the battery pack high voltage cable to drive motor inverter module.

Charge Receptacle Assembly

Remove or Disconnect

High Voltage Disconnect



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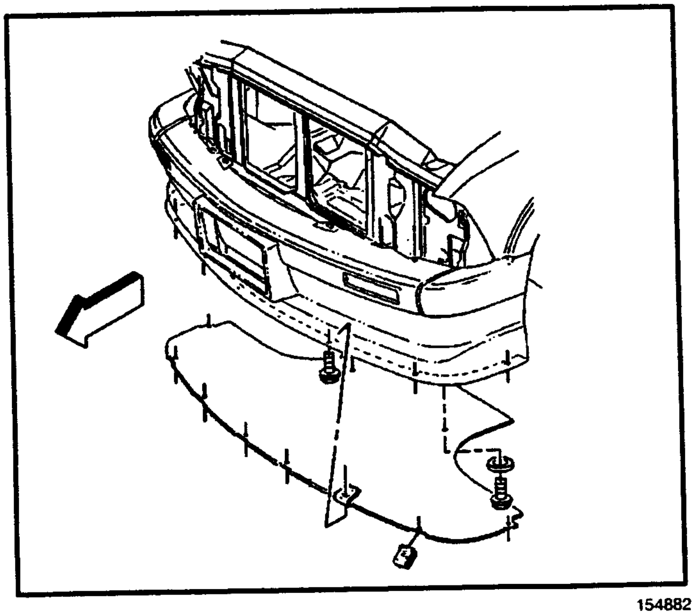
1. Remove the High Voltage Disconnect.

Air Deflector Plate



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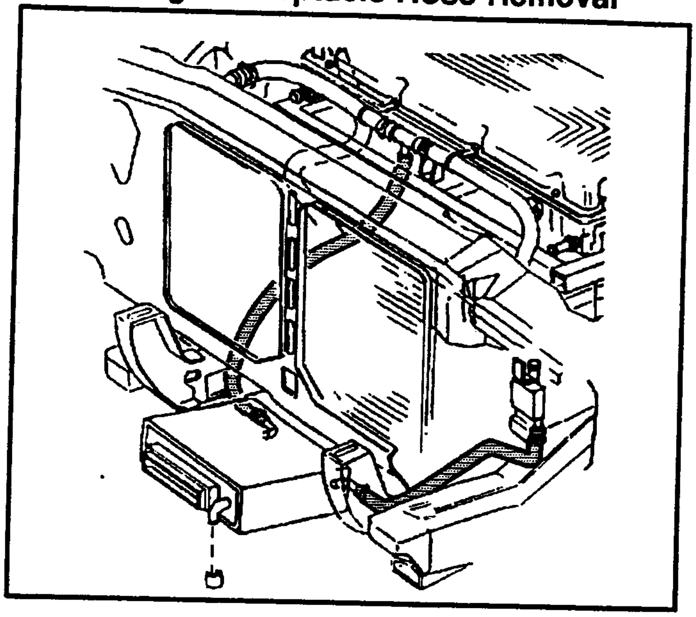
2. Remove the air deflector panel.
3. Open the radiator drain cock.
4. Drain coolant into a clean pan.
5. Close the radiator drain cock.

Charge Receptacle Hose Removal



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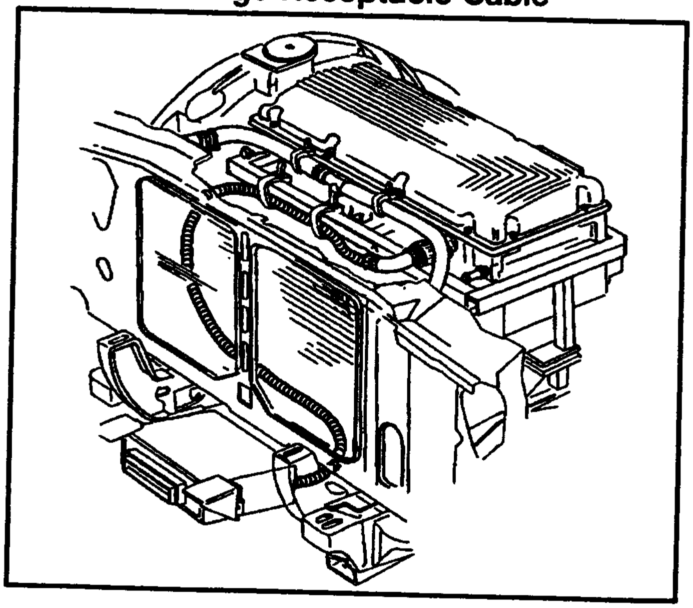
6. Remove the two coolant hoses from the charge receptacle.
7. Disconnect the 8 way electrical connector at the charge receptacle.

Charge Receptacle Cable



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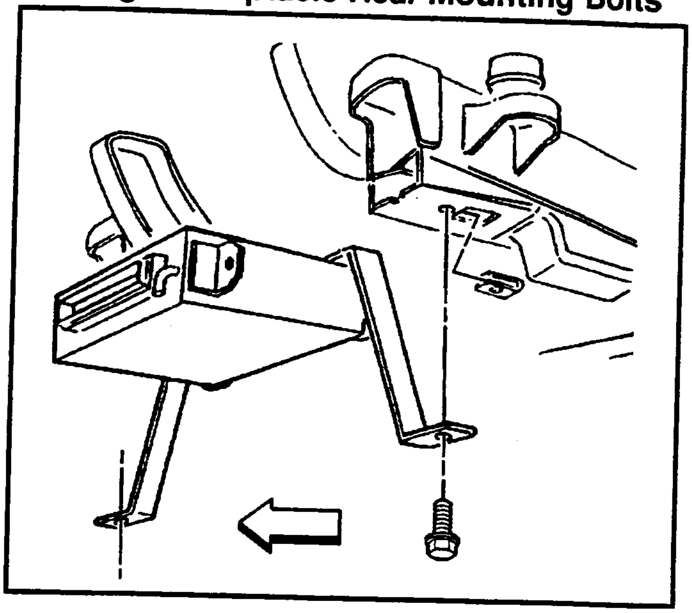
Notice: Do not remove the high voltage charge receptacle cable at the charge receptacle, vehicle damage will occur.

8. Disconnect the charge receptacle high voltage cable at the Power Inverter Module.
9. Feed the charge port high voltage cable down under the vehicle.

Charge Receptacle Rear Mounting Bolts



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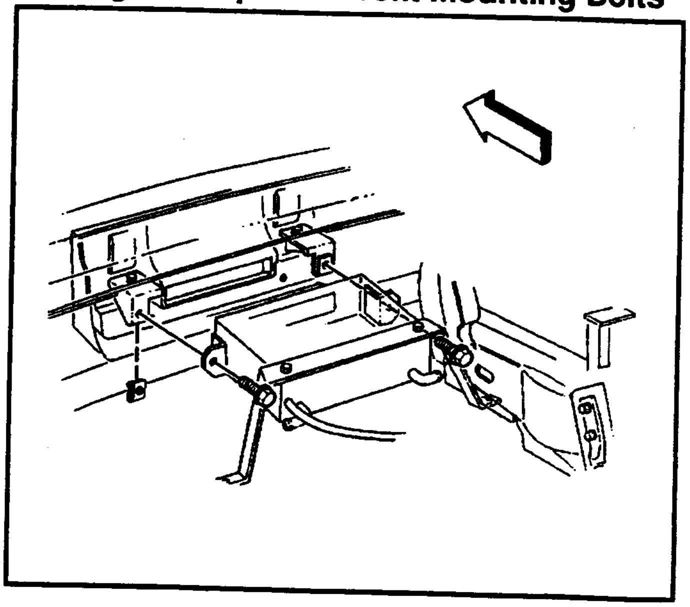
10. Remove rear charge receptacle mounting bolts.

Charge Receptacle Front Mounting Bolts



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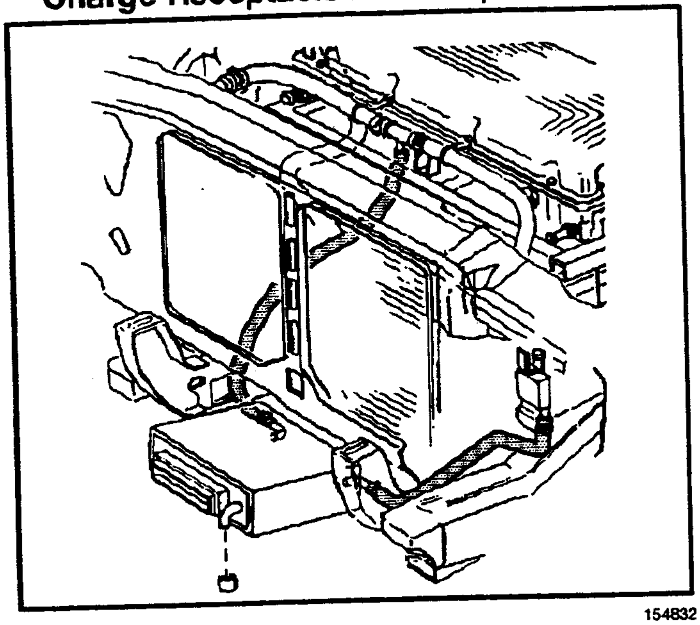
11. Remove front charge receptacle mounting bolts.
12. remove charge receptacle assembly.

Install or connect

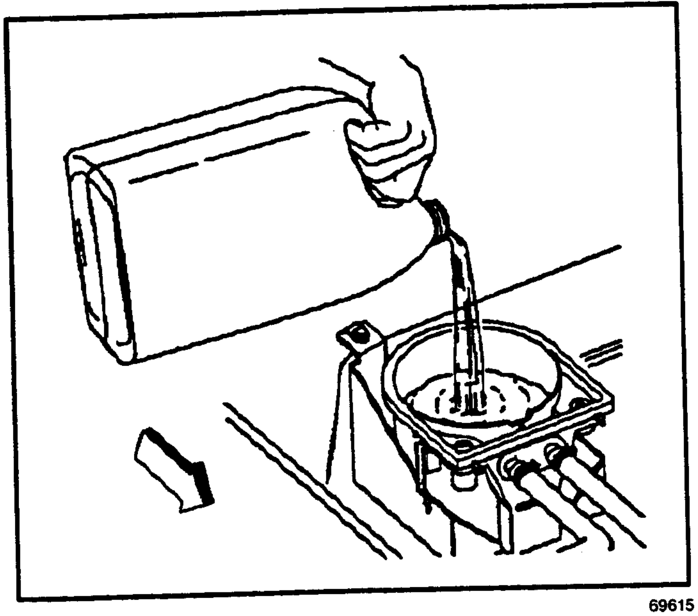
1. Install front charge receptacle mounting bolts. Tighten to 10 N•m (90 LB In).
2. Install rear charge receptacle mounting bolts. Tighten to 10 N•m (90 LB In).
3. Connect the charge receptacle high voltage cable at the drive motor inverter module.
4. Connect the 8 way electrical connector at the charge receptacle.

Charge Receptacle Hose Replacement



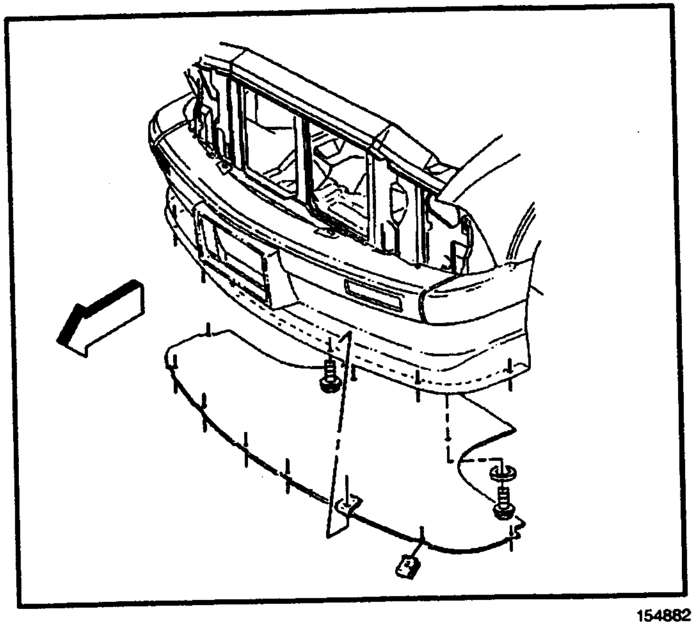
5. Connect the two coolant hoses from the charge receptacle.

Refill Coolant



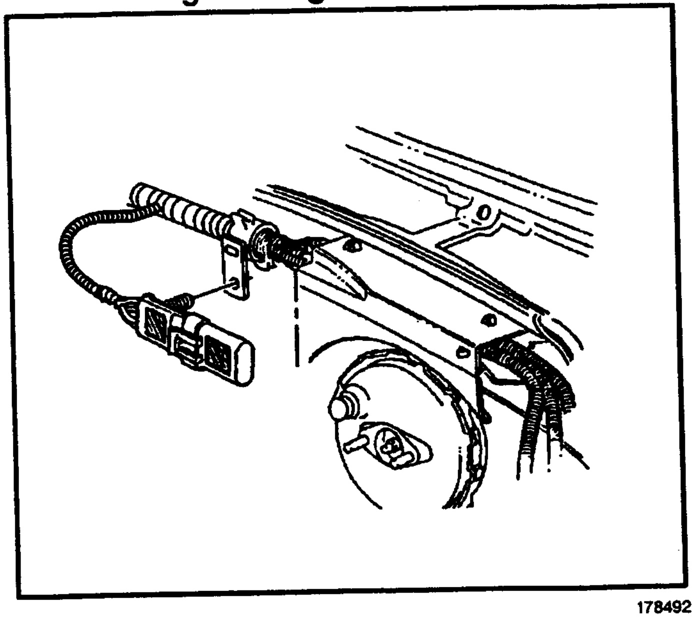
6. Refill the coolant system.

Air Deflector Plate



7. Install the air deflector panel.

High Voltage Disconnect



8. Install the High Voltage Disconnect Connector

Description and Operation

Battery Pack Control Module

The Battery Pack Control Module (BPCM) constantly monitors information from various input sensors and controls the various component systems. The BPCM also performs diagnostic tests to ensure that the systems operate correctly and have not degraded to a point where the vehicle may perform incorrectly.

Review the component sections and wiring diagrams to determine which systems are controlled by each specific control module. The BPCM monitors numerous vehicle functions and controls the following operations:

Battery Pack Control Module

- Battery Pack Charging
- Battery Temperature Requests
- State of Charge Information

Control Module Function

Each control module supplies a buffered voltage to various sensors and switches. This is accomplished through resistance in the control module which is so high in value that a test light may not illuminate when connected to the circuit. An ordinary shop voltmeter may not give an accurate reading because the voltmeter input impedance is too low. Use a 10 megohm input impedance digital Multimeter (J 39200) to assure accurate voltage readings.

The input/output devices in the control module include analog to digital converters, signal buffers, counters, and special drivers. The Control Module controls most components with electronic switches which complete a ground or voltage output circuit when turned “ON.” These switches are arranged in groups of 4 and 7, called either a surface mounted Quad Driver Module (QDSM), which can independently control up to 4 outputs terminals or Output driver Modules (ODMs) which can independently control up to 7 outputs. Certain outputs may not be used depending on vehicle application.

Auxiliary Battery Power

The auxiliary power on the electric S-10 represents the vehicles normal 12 volt accessory operating system. The storage device for this 12 volt supply is a typical automotive lead acid battery which is located in the engine compartment. Charging voltage is supplied to the auxiliary battery through the Accessory Power Control Module at a nominal 14 volts. The voltage supplied by the auxiliary battery is used for initial system power-up as well as the operation of all components with the exception of: Drive Motor, Heat Pump Compressor, Power Steering.

Phase Current

Phase current is a term used to describe the power used to turn the drive motor. Each of the three phases in the drive motor require sequential current in order to turn the drive motor shaft. The level of phase current supplied to the drive motor is determined by the Drive Motor Control Module and is dictated by inputs such as load and throttle request.

Regeneration

The PIM provides a regeneration function which allows the drive unit to supply negative shaft torque. In this mode the drive unit and the PIM act as a generator providing current to the battery assembly for storage. two different levels of regeneration are possible. During normal vehicle deceleration a maximum of 15% regeneration is allowed. During braking however, a maximum of 25% regeneration can be produced.

Vehicle Speed Limiting

The Power Inverter Module will limit vehicle speed in the forward direction to 72 mph and in reverse direction to 30 mph.

True State Of Charge (TSOC)

State of charge is a value determined by the Battery Pack Control Module. The Battery Pack Control Module constantly monitors battery assembly voltage and through numerous calculations determines a state of charge value. This value is used to calculate the approximate range and power level of the battery pack. SOC is constantly changing based on inputs to the BPCM. The factors that effect SOC are:

- Average battery pack temperature
- Lowest battery module voltage and current
- Pack voltage
- Amp-hours lost due to parasitic discharge
- Amp-hours lost due to battery pack self discharge
- Age of the batteries
- Amp-hours used
- Average current usage
- Battery pack capacity
- Battery pack capability

The BPCM stores the last rated, usable energy that a pack has whenever the charging complete criteria is met. From this point the BPCM is continually summing up how many amp-hours are flowing into and out of the battery pack.

The summing of discharging amp-hours is corrected for the temperature of the pack, the lowest battery module voltage and the rate (amps) at which current is flowing out of the batteries. The higher the temperature , the less each amp-hour counts, warm batteries react easier and are more efficient. The greater the rate (the more accelerator input), the more each amp hour count. With batteries being in a series string, the weak link controls the energy of the entire battery pack. If one module is at 35 amp-hours and the rest of the modules are at 48 amp-hours, the usable energy from the pack is only 35 amp-hours.

During charging the amp-hours going into the pack are summed up until the completion criteria is met.

Because the battery is a chemical reaction, as with all chemical reactions, temperature of the pack has an absolute affect on SOC. Therefore, the SOC will be compensated to a proportionally lower value for low pack temperatures.

User State Of Charge (USOC)

The Battery Pack Control Module sends the calculated USOC value, which is True State of Charge (TSOC) reduced by 15% to the Body Control Interface Module through serial data. This 15% reduction from TSOC is intended to prevent the driver from running the Drive motor batteries down to a very low state of charge. The Drive Motor Control Module sends a PWM signal to the Body Control Interface Module which converts the digital PWM signal to analog for the dash gauge. The Body Control Interface Module PWM conversion is performed based on 0% PWM = 0% SOC, and 100% PWM = 100% SOC.

Accessory Power Control Module

The Accessory Power Control Module has three major functions; provide 14.5 volts DC for the Auxiliary battery and 12 volt system, 3-phase AC voltage for the heat pump, and feedback to the HTCM about system operation to help diagnosis problems.

While the Accessory Power Control Module receives DC voltage that may vary from 225 to 430 volts, it must hold its output DC voltage steady for the Auxiliary battery. Additionally, the Accessory Power Control Module converts DC voltage to AC voltage to operate the heat pump compressor motor.

The Accessory Power Control Module will operate on drive motor battery voltage between 225-430 volts. The Accessory Power Control Module will shut itself down if the voltage drops below 215 volts ± 10 volts. The Accessory Power Control Module will turn on when the vehicle run commend or vehicle wake-up command inputs are active.

The PIM provides filtered high voltage DC power to the Accessory Power Control Module for distribution with an associated high voltage interlock. The maximum amps supplied to the APM is 22 amps. The PIM receives vehicle accessory power and conducts thermal energy from the Accessory Power Control Module . The PIM also supplies a ground path for the Accessory Power Control Module.

Voltage Lid

The battery pack voltage lid is a figure that is calculated from SOC, temperature, and several other inputs. The lid is used to prevent overcharging or fast discharging the battery modules.

High Voltage System

The high voltage system consists of the battery pack, Power Inverter Module, Accessory (AC and DC) Power Control Module, Power Steering Control Module, Drive Motor, and Charge Receptacle.

All of the high voltage components are interlocked. The interlock is a low voltage circuit that runs next to all of the high voltage circuits. If an open or ground in the high voltage circuit (e.g., disconnecting a high voltage connector with the relays closed) the interlock will detect this open and shut the high voltage down by opening the relays.

High Voltage Interlock Loop

The High Voltage Interlock Loop is a separate low voltage series circuit that runs along with all of the high voltage circuits. All of the high voltage DC connectors and cover switches are tied together in an isolated series single wire interlock loop allowing the auto disconnect to detect a disconnect of a high voltage component. The auto disconnect accomplishes this by applying 7.9 - 10.6 volts to the interlock loop circuit to check for a continuous loop. If a continuous loop is present the auto disconnect will monitor this voltage for a voltage drop. If a voltage between 0 -2.0 volts is detected the auto disconnect will open the relays and report this information to the BPCM. At this time the Power Inverter Module will discharge the bus capacitors so that the bus voltage is less than 42.4 volts within 250 milliseconds. The normal interlock loop voltage is 3.2 to 7.3 volts.

Auto Disconnect Chassis Ground Reference

The auto disconnect chassis ground signal provides chassis ground reference for the auto disconnect isolation protection. The auto disconnect monitors this line for continuity. If the wire is open the auto disconnect can no longer detect loss of isolation. The auto disconnect will terminate all functions and open the high voltage relays. this information is reported to the Battery Pack Control Module through the status lines

Battery Pack Automatic Disconnect System

The Battery Pack Control Module also reports any faults detected by the automatic disconnect system. This is accomplished by three states lines that are pulled low by the automatic disconnect control module. Below is a list defining the different states of the automatic disconnect state lines that run between the Battery Pack Control Module and the auto disconnect.

STATUS	LINE A	LINE B	LINE C	POWER SUPPLY
OK	0V	0V	0V	5V
LOSS OF ISOLATION	5V	5V	5V	5V
GROUND LOSS	5V	5V	0V	5V
INTERLOCK	0V	5V	5V	5V
LOW PACK VOLTAGE	5V	0V	5V	5V
BPCM COMMANDED OPEN	0V	5V	0V	5V
CAPACITOR PRECHARGE	5V	0V	0V	5V
CAPACITOR PRECHARGE FAULT	0V	0V	5V	5V

The auto disconnect contains a controller, two high voltage relays, two high watt resisters (resister are part of the wiring harness) and a wiring harness. The auto disconnects primary function is to detect a malfunction in the high voltage system and open the relays disconnecting the high voltage from underhood. When the vehicle is operating properly the relays will remain closed unless a fault is detected or the manual high voltage disconnect is removed. The normal operation condition of the high voltage relays in the vehicle is closed however, if all power was removed and the relay was being bench tested the relays would be open.

When a fault is detected, with the exception of an isolation fault or a Battery Pack Control Module command to open the relays, the auto disconnect will open the relays disabling propulsion. If an isolation fault is detected the auto disconnect will inform the Battery Pack Control Module and if vehicle speed is greater than 1km/h the Battery Pack Control Module will not allow the auto disconnect to open the relays. When vehicle speed is less than 1km/h for three minutes or the vehicle is placed in park for 10 seconds the Battery Pack Control Module will allow the auto disconnect to open the relays. Additionally if the Battery Pack Control Module detects a low pack state of charge (true SOC), sever under or over voltage the Battery Pack Control Module will command the auto disconnect to open the high voltage relays when the above speed criteria is met.

The only other time the relays will open is when the manual high voltage disconnect is pulled.

Manual High Voltage Disconnect

The manual disconnect connector is located under the hood near the power brake booster. The high voltage disconnect connector is the end of a four wire extension from the automatic disconnect. By removing the connector the ground path to the high voltage relays is removed. At the same time a internal battery pack ground unbalance is created that requires the automatic disconnect to command the high voltage open. The high voltage disconnect connector should be locked in the glove-box or other secure area during vehicle service.

Isolation Detection

High voltage is isolated (resistance measured to chassis ground) from chassis ground. The auto disconnect shall check for a loss of isolation to ground of either the high voltage negative or the high voltage positive leads. This shall be accomplished by measuring the voltage between chassis ground and each of the high voltage leads and looking for an imbalance, less than 30 percent or greater than 70 percent of pack voltage. If the voltage does not fall within the above limits an isolation fault is set.

Precharge

To close the high voltage relays the auto disconnect system goes through a precharge. Precharge allows closing of the positive bus relay with a small voltage potential to prevent arcing. A precharge capacitor is located in the power inverter module. When the vehicle is placed in the RUN mode, and the relays are open, the negative bus relay and the low current relay in the auto disconnect controller will close allowing the PIM capacitor to charge. Precharge will occur until a voltage of 90% of the battery pack voltage has been reached. At this time the positive bus relay will close and the precharge low voltage relay in the auto disconnect controller will open allowing normal system operation. The auto disconnect will charge the PIM capacitor to 90% of the battery pack voltage within seven seconds and the pack current from the low voltage relay will be no greater than three amps. If precharge is not completed within 10 seconds then a precharge fault will occur and all relays will be commanded open and the WAIT lamp will be illuminated.

Charge Receptacle

The charge receptacle receives its high voltage from a charger. The input power is AC from a wall 110 volt or 220 volt outlet. The charge receptacle converts this AC power to DC power. This DC power is passed through the Power Inverter Module high voltage bus to the battery pack for charging the battery modules. Any open or shorting of the charge receptacle will be sensed by the auto disconnect system and the battery pack control module will shut off the charging function.

Charger Communications

The charger communicates with the Drive Motor Battery Control Module on the class II data bus. Radio transmitter/Receivers located in the charger and charge port exchange information while the charge paddle in inserted into the vehicle. Information is passed relating to charger faults, state of charge, current request, charge time, ect.

Run 1 Power

Run 1 power is the 12 volt aux. battery supplied voltage used to initiate vehicle operation through the ignition switch. When the key is turned forward the run 1 circuit is energized and base power is supplied to the primary control modules.

Run 2 Power

Run 2 power is the 12 volt supply that is needed to initiate propulsion. Run 2 power is controlled through the HTCM and supplied by the PIM relay located behind the glove box.

Vehicle Wake-up

The vehicle wake-up circuit is used to activate only the systems needed to charge the Drive Motor Battery Assembly with the ignition switch off. At the time the charge paddle is inserted into the charge port a 12 volt supply is sent to the Drive Motor Battery Control Module and the HTCM. At the same time the charger begins sending class II messages on the bus informing the Drive Motor Battery Control Module that vehicle charging is ready to take place. After the charge receptacle or HTCM has sent the wake-up signal, the Battery Pack Control Module wakes up and takes over supplying the 12 volts to the wake-up circuit. Only after the Battery Pack Control Module is ready to power down will it remove the power to the wake-up line.

Periodic Wakeup

The S-10 Electric has a feature called periodic wake-up. HTCM has an internal clock that begins counting down from 24 hours after the vehicle has been powered down. If the HTCM does not receive a wake-up signal within 24 hours the HTCM itself will assert the vehicle wake-up circuit.

Battery Pack

The battery pack always has high voltage DC present. The nominal voltage of the battery pack is 312 volt and approaches higher voltages during charging or regeneration. The voltage in the battery pack is sent to the vehicle Power Inverter Module by two large relays. When these relays are closed the 312 volts are present at the Power Inverter Module.

The drive motor battery assembly (battery pack) contains 26 battery modules, a battery pack control module, and a automatic disconnect. The main function of the battery pack is to provide energy to the power inverter module to be converted to AC power for the drive motor.

The 26 battery modules are wired in series along with a shunt and a fuse. This series circuit is then tied to two high voltage relays which are controlled by the automatic disconnect controller. Under normal operating conditions the relays are always closed even with the key OFF, however if a fault in the high voltage system is detected or the high voltage disconnect connector is removed the relays will be open and high voltage is contained within the pack.

When the vehicle is placed in the RUN mode and the high voltage relays are open, the automatic disconnect will close the negative bus high voltage relay and precharge a capacitor in the Power Inverter Module. Once the capacitor is charged to 90% of the battery pack voltage the positive side high voltage relay will close allowing high voltage to be connected to the Power Inverter Module for use as drive motor power.

Drive Motor Battery Modules

Batteries are energy storage devices used to convert chemical energy into electrical energy through chemical reactions. The S-10 Electric batteries are a valve regulated lead acid battery (VRLA). These batteries contain only a small amount of liquid which is predominately absorbed by a glass matte material, Where in a typical automotive battery the cells are flooded. The lead acid battery contains six cells at two volts each which provides an overall battery module voltage of 12 volts. In each cell are positive and negative lead plates with lead sulfate as a paste coating. The positive plates are placed in a absorptive glass matte material which contains the sulfuric acid as the electrolyte. The chemical reaction is between lead, lead oxide and sulfuric acid. After the reaction takes place lead sulfate and water are produced. As the battery is discharged, the sulfuric acid decreases and therefore the battery voltage decreases. VRLA batteries have a limited amount of acid available as compared to regular automotive batteries which have flooded cells.

The VRLA batteries should not operate consistently at module voltages of 10.5 volts or lower. Operating in this region will cause build up on the plates. The plate build up reduces the amount of active material therefore reducing the capacity of the battery. Additionally, batteries subjected to extreme gassing will tend to dry out the batteries and can reduce the capacity, and life of the battery.

Battery Capacity

Capacity is the amount of energy the battery module can deliver at a given voltage. The capacity is measured in amp-hours which is how many amps the battery can deliver over a period of time.

Capacity is affected by many factors: temperature, Manufacturing, rate of discharge, and the normal chemical process over time.

- Temperature has one of the greatest effects on the battery module. When temperatures are warm the fluid is thin and the chemical reaction takes place much easier than in cold temperatures. In cold temperatures the capacity can be cut in half until the battery temperatures increase. The loss of capacity due to temperatures only temporary. As the battery temperature increases the capacity will continue to increase to its maximum capacity. Although the battery capacity increases with warmer temperatures there is a negative impact if batteries are ran at temperatures of 60°C (140°F) and above. At these temperatures battery corrosion is accelerated and can impact the life of the battery.
- Manufacturing of the battery module also plays a part in there overall capacity. If one battery module is manufactured with more active material that battery module has a potential for added capacity.
- The rate the battery module is discharged can also effect the capacity of the battery module. The slower the battery module is discharged the more time is allowed for the material to react and stay active. Discharging the battery at a very high rate will prevent some material from reacting therefore reducing the overall capacity.
- In the normal chemical process over time, the material breaks down and is consumed allowing the amount of active material to be reduced. The reduction of this active material reduces the capacity of the battery module.

Because the batteries in the S-10 Electric are wired in series the amount of amp-hours in a battery pack is controlled by the battery module with the lowest amp-hour capacity. The performance of the battery is not affected by the capacity however, the range, or amount of miles the vehicle can travels directly affected by capacity. The capacity will decrease overtime at different rates depending on how the vehicle is operated and how the battery modules were made. If vehicle mileage demands are high, the vehicle operator will notice a overall reduction in miles per charge.

Battery Life Cycle

The battery cycle life is the amount of charge/discharge cycles a battery can take before it no longer meets the minimum capacity requirements. One significant factor in cycle life is corrosion which is caused by oxidation and hydrogen reduction. The corrosion process is accelerated when the vehicle is operated in high temperatures. Another significant factor in life cycle is the depth of discharge. The deeper the discharge the harder it becomes to reverse the chemical reaction when charging. This can reduce the amount of material available for use in the next drive cycle.

Battery Pack Charging

When the charge paddle is installed into the charge receptacle the battery pack control module (BPCM) is sent a wake-up signal from the charge receptacle. The BPCM will go through a set of checks with the charger via the charge receptacle which passes class II information to the charger through radio communications. There is no hard wiring between the charger and the charge receptacle. When the charger and the BPCM initialization is complete the BPCM and charger pass system status. Next, the BPCM will request a percentage of maximum power required for charging. This request is updated as the vehicle charges to complete. The power from the charge receptacle is rectified to DC in the charge receptacle and passes through the PIM to the battery pack.

Battery charging is based on pack voltage, module voltage, charge receptacle temperature, battery pack temperature, and auxiliary battery voltage. The BPCM continually monitors the above values and adjusts its request of power to the charger as the vehicle charges.

Battery Pack Battery Module Equalization

The Battery Pack Control Module will perform a complete battery module voltage equalization on the entire Battery pack. This process is done during charging. After the battery pack is at a nearly complete SOC the Battery Pack Control Module will instruct the charger, through Class II communication, to reduce to charge current and trickle charge the battery pack. This process allows each individual battery module to achieve a common voltage value and increases the storage capacity of the entire battery pack. The charger will indicate that this process is complete by displaying Full.

Battery Pack Control

The BPCM monitors each of the 26 battery modules separately. This is accomplished by sense leads connected at each module positive terminal. The BPCM will initialize the sense leads to read across one battery module at a time. The sense leads are placed across a capacitor inside the BPCM which is charged to the voltage potential of the battery module being measured. Once the capacitor is charged the BPCM will read the voltage across the capacitor and compare it to the normalized module voltage. Normalized module voltage is calculated by reading battery pack voltage at a point in time and dividing by 26. If a battery module voltage is a calibrated delta from the normalized voltage, a low voltage compared to current draw, or less than one volt, the BPCM will set a code indication a battery module or system problem.

Battery Pack Current Shunt

The BPCM measures current by using a shunt. A shunt is a precision resistor with a known value. The BPCM uses the voltage reading across the shunt and the known resistance to calculate the current entering of exiting the battery pack. This information is used for charging, SOC, and range calculations and diagnostics. The current shunt will have an accuracy of ± 0.5 amps at 0-17 amps draw ± 3 percent at greater than 17 percent draw.

Resistance:	0.42 milliohms
Nominal Voltage:	312 volts
Maximum Voltage:	430 volts
Minimum Voltage:	225 volts
Nominal Current:	50 amps
Maximum Current:	175 amps for two minutes
	472 amps for 15 seconds

Battery Pack Voltage Sense

Battery pack voltage is also measured by two sense leads, one at module #1 and the other at module #26. This voltage is monitored by the BPCM and used for pack control and diagnostics.

The battery pack is protected by a fuse with the following ratings:

- 472 amps at 343 volts for 30 seconds minimum.
- Minimum fuse voltage rating: 500 volts.

Battery Pack Temperature Control

The Battery Pack Control Module also monitors six temperature sensors. this information is used to calculate battery energy, SOC, and HTCM heating and cooling requirements. The pack also contains an air inlet temperature sensor and an air flow sensor. The air inlet temperature sensor measures the temperature of the air that is entering the pack. The air flow sensor determines that air is actually flowing into the pack.

Battery Pack Vent System

The battery pack has a vent system which plays a vent critical roll in assuring no gases are allowed to build up in the battery pack. Every battery is connected to the vent system. The system routs through all of the batteries and out the front of the battery pack, and is strapped on the high voltage cable. On the end of the vent tube is a filter used to keep the system clean from contaminates. The material used for the vent system is a special material and should never be substituted with another material. Us only genuine GM parts for this application. Whenever the battery pack is worked on, make sure the vent system check is performed to ensure proper operation.

Use of Circuit Testing Tools

Do not use a test light to diagnose the Powertrain electrical systems unless specifically instructed by diagnostic procedures. Use Connector Test Adapter Kit, J 35616 whenever diagnostic procedures call for probing any connectors.

Control Module Service Precautions

The control module is designed to withstand normal current draws associated with vehicle operations. Avoid overloading any circuit. When testing for opens or shorts, do not ground or apply voltage to any of the control module circuits unless instructed to do so. These circuits should only be tested using digital voltmeter J 39200, while the control module connectors remain connected to the control module or the recommended breakout box

Electrostatic Discharge (ESD) Damage

Electronic components used in the control systems are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. Less than 100 volts of static electricity can cause damage to some electronic components. By comparison, it takes as much as 4,000 volts for a person to even feel the zap of a static discharge.

There are several ways for a person to become satirically charged. The most common methods of charging are by friction and by induction. An example of charging by friction is a person sliding across a car seat.

Charging by induction occurs when a person with well insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off leaving the person highly charged with the opposite polarity. Static charges can cause damage, therefore, it is important to use care when handling and testing electronic components.

Notice: To prevent possible Electrostatic Discharge damage, follow these guidelines:

- Do not touch the control module connector pins or soldered components on the control module circuit board.
- Do not open the replacement part package until the part is ready to be installed.
- Before removing the part from the package, ground the package to a known good ground on the vehicle.
- If the part has been handled while sliding across the seat, or while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.

Maintenance Schedule

Refer to the *General Motors Maintenance Schedule* for the maintenance that should be performed to retain vehicle performance.

Visual/Physical Underhood Inspection

Caution: Always disconnect the High Voltage Disconnect Connector and check both the Drive Motor Control Module and the Battery Pack Control Module for DTCs before performing any physical inspection or service. This connector is located under the hood and is identified with a White label.

Perform a careful visual and physical underhood inspection when performing any diagnostic procedure or diagnosing the cause of an on-board diagnostic test failure. This can often lead to repairing a problem without further steps. Use the following guidelines when performing a visual/physical inspection:

- Inspect all wires in the engine compartment for proper connections, burned or chafed spots, pinched wires, contact with sharp edges.
- Always treat high voltage systems as if high voltage is present regardless of whether any problems are seen during a visual inspection.

This visual/physical inspection is very important. It must be done carefully and thoroughly.

Basic Knowledge Of Tools Required

A basic understanding of hand tools is necessary to effectively use this section of the Service Manual.

Notice: Lack of basic knowledge of this Powertrain when performing diagnostic procedures could result in incorrect diagnosis or damage to Powertrain components. Do not attempt to diagnose a Powertrain problem without this basic knowledge.

Wiring Harness Service

Never repair any damaged high voltage cables or harness. Damaged high voltage wiring should always be replaced.

The control module harness electrically connects the control module to the various solenoids, switches and sensors in the vehicle engine compartment and passenger compartment.

Replace wire harnesses with the proper part number replacement.

Because of the low amperage and voltage levels utilized in Powertrain control systems, it is essential that all wiring in environmentally exposed areas be repaired with crimp and seal splice sleeves.

The following wire harness repair information is intended as a general guideline only. Refer to Electrical Diagnosis for all wire harness repair procedures.

Connectors And Terminals

Use care when probing a connector and when replacing terminals. It is possible to short between opposite terminals. Damage to components could result. Always use jumper wires between connectors for circuit checking. NEVER probe through Weather-Pack seals. Use tachometer adapter J 35812, or equivalent, which provides a convenient connection to the tachometer lead. The connector test adapter kit J 35616, or equivalent, contains an assortment of flexible connectors used to probe terminals during diagnosis. Fuse remover and test tool BT-8616, or equivalent is used for removing a fuse and to adapt the fuse holder to a meter for diagnosis.

Open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor, or in the wiring harness may temporarily correct the open circuit. Intermittent problems may also be caused by oxidized or loose connections.

Be certain the type of connector/terminal before making any connector or terminal repair. Weather-Pack and Com Pack III terminals look similar, but are serviced differently.

(Serial Data Communication)

UART Serial Data

Two methods of data transmission are used. One method involves a Universally Asynchronous Receiving/Transmitting (UART) protocol. UART is an interfacing device that allows the on board computer to send and receive serial data. "Serial data" refers to information which is transferred in a linear fashion - over a single line, one bit at a time. A "data bus" describes the electronic pathway through which serial data travels. The UART receives data in a serial format, converts the data to parallel format, and places them on the data bus (which is recognizable to the on board computer). The UART also accepts parallel data from the data bus, converts the data to serial format, and transmits them to the Tech 2 or other scan tools. This method has been the common strategy for establishing a communication link between the on board control module and the off board monitor/scanner since 1981.

Class II Serial Data

U.S. Federal regulations require that all automobile manufacturers establish a common communications system. General Motors utilizes the "Class II" communications system. Each bit of information can have one of two lengths: long or short. This allows vehicle wiring to be reduced by the transmission and reception of multiple signals over a single wire. The messages carried on Class II data streams are also prioritized. In other words, if two messages attempt to establish communications on the data line at the same time, only the message with higher priority will continue. The device with the lower priority message must wait. The most significant result of this regulation is that it provides scan tool manufacturers with the capability of accessing data from any make or model vehicle sold in the United States.

The data displayed on the Tech 2 or other scan tools will appear the same, with some exceptions. Some scan tools will only be able to display certain vehicle parameters as values that are a coded representation of the true or actual value. For more information on this system of coding, refer to section on decimal/binary/hexadecimal conversions. On GM automobiles, the Tech 2 displays the actual values for vehicle parameters. It will not be necessary to perform any conversions from coded values to actual values.

Diagnostic

The word *diagnostic* refers to any on-board test run by the vehicles Diagnostic Management System. A diagnostic is simply a test run on a system or component to determine if the system or component is operating according to specification.

Enable Criteria

The term "enable criteria" is engineering language for the conditions necessary for a given diagnostic test to run. Each diagnostic has a specific list of conditions which must be met before the diagnostic will run. "Enable criteria" is another way of saying "conditions required".

The enable criteria for each diagnostic is listed on the first page of the DTC description under the heading "Conditions for Setting the DTC". Enable criteria varies with each diagnostic.

Freeze Frame

Freeze Frame is an element of the Diagnostic Management System which stores various vehicle information at the moment an emissions-related fault is stored in memory and when a MIL is commanded on. This data can help to identify the cause of a fault. Refer to *Storing And Erasing Freeze Frame Data* for more detailed information.

Failure Records

Failure Records data is a GM enhancement of the OBD II Freeze Frame feature. Failure Records store the same vehicle information as does Freeze Frame, but it will store that information for any fault which is stored in on-board memory, while Freeze Frame stores information only when the MIL is commanded on.

Diagnostic Information

The diagnostic charts and functional checks are designed to locate a faulty circuit or component through a process of logical decisions. The charts are prepared with the requirement that the vehicle functioned correctly at the time of assembly and that there are not multiple faults present.

There is a continuous self-diagnosis on certain control functions. This diagnostic capability is complimented by the diagnostic procedures contained in this manual. The language of communicating the source of the malfunction is a system of diagnostic trouble codes. When a malfunction is detected by a control module, a diagnostic trouble code is set and a Malfunction Indicator Lamp (MIL) "SERVICE SOON", "SERVICE NOW" or "BATT LIFE" may be illuminated.

Malfunction Indicator Lamps (MILs)

The Malfunction Indicator Lamps (MILs) may be turned on when one or more control modules detect a fault that requires a DTC to be set.

Each MIL is under the control of a specific control module. Any control module can send a MIL illumination request to another control module through the serial data line. Direct MIL illumination responsibilities are as follows:

Drive Motor Control Module

- Temp
- Service Soon

Drive Motor Battery Control Module

- Service Now
- Batt Life
- Wait

Extinguishing the MIL

When the MIL is on, the control module may turn off the MIL as soon as a test passed has been reported for the diagnostic test that originally caused the MIL to illuminate.

Although the MIL has been turned off, the DTC will remain in the memory (both Freeze Frame and Failure Records).

When the MIL remains "ON" or when a malfunction is suspected due to a driveability problem, a *On-Board Diagnostic (OBD) System Check must be performed.* The procedures for these checks are given in Propulsion Control Systems. These checks will expose faults which may not be detected if other diagnostics are performed first.

Storing And Erasing Freeze Frame Data and Failure Records

Government regulations require that engine operating conditions be captured whenever the MIL is illuminated. The data captured is called *Freeze Frame* data. The freeze frame data is very similar to a single record of operating conditions. Whenever the MIL is illuminated, the corresponding record of operating conditions is recorded to the freeze frame buffer.

Freeze frame data can only be overwritten with data associated with a misfire or fuel trim malfunction. Data from these faults take precedence over data associated with any other fault. The freeze frame data will not be erased unless the associated history DTC is cleared.

Each time a diagnostic test reports a failure, the current operating conditions are recorded in the *Failure Records* buffer. A subsequent failure will update the recorded operating conditions. The following operating conditions for the diagnostic test which failed *typically* include the following parameters:

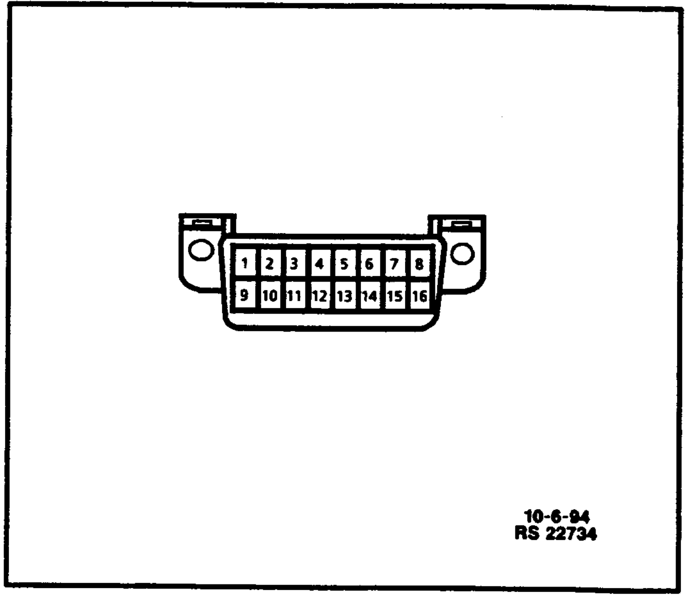
- Battery State of Charge
- Battery Pack Temperature
- Drive Motor Winding Temperature
- Power Inverter Module Temperature
- Drive Motor Speed
- Drive Motor Direction
- System High Voltage State

Intermittent Malfunction Indicator Lamp

In the case of an "intermittent" fault, the MILs (Service Soon, Service Now or Batt Life) may illuminate and then (after a diagnostic pass) go "OFF". However, the corresponding diagnostic trouble code will be stored in the memory. When unexpected diagnostic trouble codes appear, check for an intermittent malfunction.

A diagnostic trouble code may reset. Consult the "Diagnostic Aids" associated with the diagnostic trouble code. A physical inspection of the applicable sub-system most often will resolve the problem.

Data Link Connector (DLC)



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Data Link Connector (DLC)

The provision for communicating with the control module is the Data Link Connector (DLC). It is usually located under the instrument panel. The DLC is used to connect to a scan tool. Some common uses of the scan tool are listed below:

- Identifying stored Diagnostic Trouble Codes (DTCs).
- Clearing DTCs
- Performing output control tests.
- Reading serial data.

Decimal/Binary/Hexadecimal Conversions

Beginning in 1996, Federal Regulations require that all auto manufacturers selling vehicles in the United States provide scan tool manufacturers with software information to display vehicle operating parameters. All scan tool manufacturers will display a variety of vehicle information which will aid in repairing the vehicle. Some scan tools will display encoded messages which will aid in determining the nature of the concern. This method of encoding involves the use of a two additional numbering systems: Binary and Hexadecimal.

The binary number system has a base of two numbers. Each digit is either a 0 or a 1. A binary number is an eight digit number and is read from right to left. Each digit has a position number with the farthest right being the 0 position and the farthest left being the 7 position. The 0 position, when displayed by a 1, indicates 1 in decimal. Each position to the left is double the previous position and added to any other position values marked as a 1.

The hexadecimal system is composed of 16 different alpha numeric characters. The alpha numeric characters used are numbers 0 through 9 and letters A through F. The hexadecimal system is the most natural and common approach for scan tool manufacturers to display data represented by binary numbers and digital code.

Reprogramming ("Flashing") The Control Modules

Some vehicles allow reprogramming of the control module without removal from the vehicle. This provides a flexible and a cost-effective method of making changes in software and calibrations.

Reprogramming the Battery Pack Control Module will effect the learned state of charge value that is shared with the Drive Motor Control Module and the state of charge gauge on the dash. In order for the Battery Pack Control Module to relearn the SOC the key should be cycled twice immediately after reflashing then the battery pack must be charged to completion.
NOTICE: After the Battery Pack Control Module is reprogrammed, the charger will indicate 0% SOC regardless of the SOC displayed by the charger before Battery Pack Control Module reprogramming.

The Service Programming System (SPS) will not allow incorrect software programming or incorrect calibration changes. Refer to the latest Techline information on re-programming or flashing procedures.

Verifying Vehicle Repair

Following a repair, the technician should perform the following steps:

1. Review and record the fail records and/or freeze frame data for the DTC which has been diagnosed.
2. Clear DTC(s).
3. Operate the vehicle within conditions noted in the fail records and/or freeze frame data.
4. Monitor the DTC status information for the specific DTC which has been diagnosed until the diagnostic test associated with that DTC runs.

Following these steps are very important in verifying system repairs. Failure to follow these steps could result in unnecessary repairs.

Reading Diagnostic Trouble Codes Using a Tech 2 or Other Scan Tool

The procedure for reading diagnostic trouble code(s) is to use a diagnostic scan tool. When reading DTC(s), follow instructions supplied by tool manufacturer.

Clearing Diagnostic Trouble Codes

Important: Do not clear DTCs unless directed to do so by the service information provided for each diagnostic procedure. When DTCs are cleared, the Freeze Frame and Failure Record data which may help diagnose an intermittent fault will also be erased from memory.

If the fault that caused the DTC to be stored into memory has been corrected, the Battery Pack Control Module will begin to count the Power Transfer Cycles. When it has counted 100 consecutive cycles with no further faults detected, the DTC will automatically be cleared from memory. The Drive Motor Control Module will store history DTCs until manually removed.

To clear Diagnostic Trouble Codes (DTCs), use the diagnostic scan tool "clear DTCs" or "clear information" function. When clearing DTCs follow instructions supplied by the tool manufacturer. In some cases it may be necessary to cycle the key after the fault is no longer present in order to clear DTCs with the scan tool.

DTC Modes

Use the DTC Info mode to search for a specific type of stored DTC information. There are several choices. The service manual may instruct the technician to test for DTCs in a certain manner. Always follow published service procedures.

To get a complete description of any status, press the Enter key before pressing the desired F-key. For example, pressing enter, then a F key will display a definition of the abbreviated scan tool status.

Current DTC

This message displayed indicates that the diagnostic test has failed at least once during the current ignition cycle. This message will clear when DTCs are cleared or the ignition is cycled.

History DTC

This message displayed indicates that the DTC has been stored to memory as a valid fault. A DTC displayed as a History fault does not necessarily mean that the fault is no longer present. The history description means that all the conditions necessary for reporting a fault have been met (maybe even currently) and the information was stored to the control module memory.

MIL Requested

This message displayed indicates that the DTC is currently causing the MIL to be turned "ON". The MIL request cannot be used to determine if the DTC fault conditions are currently being experienced.

Failure Records

Failure records are stored in system memory for some diagnostic trouble codes. Failure records show the conditions the vehicle was in at the time the DTC set. This information may be useful when trying to duplicate conditions for intermittent problems. In the case of the S-10 electric this information is also useful in determining the battery pack state of charge at the time a battery module DTC sets.

Battery Condition Records

The Battery Pack Control Module reserves an area to store information related to Battery Performance and Out of Range DTC(s). When a battery or batteries fall within the conditions to set a Battery Performance or Out of Range DTC the information will be stored in the Battery Pack Control Module and can be viewed with the Tech 2 scan tool. The Battery Pack Control Module can store information on up to six (6) separate batteries and has the ability to count the number of times the battery reports the same fault.

Information Sensors

Battery Pack Temperature Sensors

The battery pack has six temperature sensors connected to the negative end of battery modules #8, 13, 18, 24, 25, and 26. The sensors are variable resistance sensors which are pulled up to five volts and grounded in the Battery Pack Control Module. These temperature sensors are used by the Battery Pack Control Module for calculating SOC, thermal control, and for charge control. The Battery Pack Control Module uses the average battery pack temperature for these calculations. The maximum battery temperature is used for charging control.

TEMPERATURE SENSOR LOCATION TABLE			
Sensor #	Battery #	Sensor #	Battery #
Temp 1	Battery 8	Temp 4	Battery 24
Temp 2	Battery 13	Temp 5	Battery 25
Temp 3	Battery 18	Temp 6	Battery 26

The Battery Pack Control Module will continue to use the temperature average and maximum value until two or more sensors have failed. At this time the Battery Pack Control Module will set the service soon lamp and disable charging. When fore temp sensors have failed the Battery Pack Control Module will substitute 27°C (81°F) for pack temperature.

The normal resistance vs temperatures are shown in the table below.

Battery Pack Temperature Sensor vs Resistance

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	1M
-35	-31	72K
-30	-22	52.4K
-25	-13	38.5K
-20	-4	28.5K
-15	5	21.3K
-10	14	16K
-5	23	12K
0	32	9.4K
5	41	7.2K
10	50	5.6K
15	59	4.4K
20	68	3.5K
25	77	2.8K
30	86	2.2K
35	95	1.8K
40	104	1.5K
45	113	1.2K
50	122	997
55	131	806
60	140	669
65	149	548
70	153	467

Air Inlet Temperature Sensor

The air inlet temperature sensor is used by the Battery Pack Control Module to detect the temperature of the air entering the pack.

The temperature vs resistance values for this sensor are the same as the battery temperature sensor shown above.

Battery Pack Blower Air Flow Sensor

This air flow sensor is used by the Battery Pack Control Module to verify that the pack blower fan is putting air into the battery pack tunnel. The air flow temp sensor is located in the air intake tube before the pack blower fan. The air flow sensor is a self-heating thermistor connected with a series resister (35 ohm) to the Run1/ wake-up signal.

Sensor resistance:

- Minimum = 70 ohms
- Maximum = 1000 ohms

The operating voltage is 0.5 volts to 4.5 volts.

As air blows over the heated sensor the resistance increases therefore changing the voltage level to the Battery Pack Control Module. This indicates that air is flowing past the sensor.

Charge Receptacle Temperature

The charge receptacle provides an analog temperature signal to the BPCM for use in indicating charge receptacle temperature. During no-charging modes the charge receptacle temperature circuit is open. When the charge paddle is inserted the circuit is closed allowing the BPCM to read temperature and paddle present. The temperature sensor is internal to the charge receptacle and is not serviced separately. The characteristics of the sensor are as follows:

- Five volt supply from the BPCM

Charge Receptacle Temperature vs Resistance

°C	°F	OHMS
Temperature vs Resistance Values (Approximate)		
-40	-40	336500
-30	-22	177000
-20	-4	97070
-10	14	55330
0	32	32650
10	50	19900
20	68	12490
30	86	8057
40	104	5327
50	122	3603
60	140	2488
70	158	1752
80	176	1258
90	194	918
100	212	680
110	230	511
120	248	389
130	266	301
140	284	235
150	302	185

Automatic High Voltage Disconnect

The automatic disconnect is located inside and receives power from the Drive Motor Battery Assembly. If the auto disconnect detects or receives information from another control module that there is a problem with the high voltage system it will open the high voltage relays. Problems with the high voltage range from interlock loop faults to loss of ground in a high voltage component.

Battery Module Voltage Sense Leads

Each of the 26 battery modules is connected to one another by a battery interconnect cable. Spliced into each interconnect cable is a voltage sense lead used to inform the Battery Pack Control Module of the individual battery module voltage. Each sense lead cable has a 30.9K ohm resistor in-line to limit current to the Battery Pack Control Module.

Discrete Input

A discrete input describes a method of transmitting information from a control module or component to another control module without the use of serial communications. This is normally done by using a signal wire that changes electrical state to indicate the presence or absence of a monitored condition. Due to the nature of discrete inputs 1 bit of data is exchanged between components, the line is simply ON or OFF.

Special Tools and Equipment

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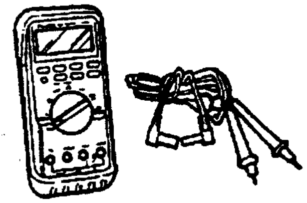
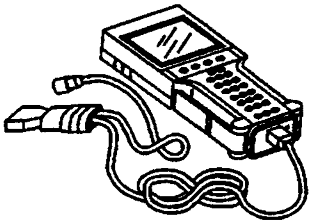
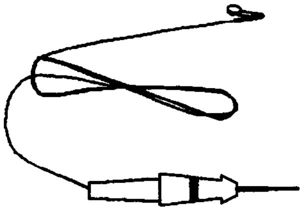
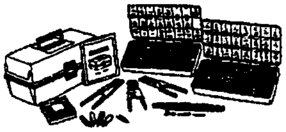
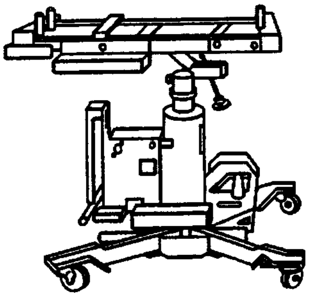
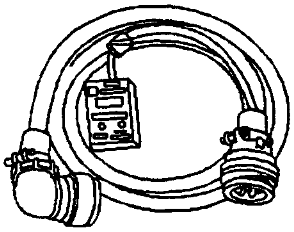
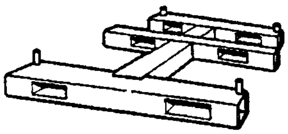
 65709	J 39200 Digital Multimeter
 39438	Tech 2 Scan Tool
 8440	J 34142-B 12 Volt Test Light
 8440	J 38125-A Packard Terminal Repair Kit
 179013	J 42187 Battery Pack Lift Table
 160326	J 42493 Battery Pack to Power Inverter Module Extension
 182411	J 42500 Battery Pack Support Tray

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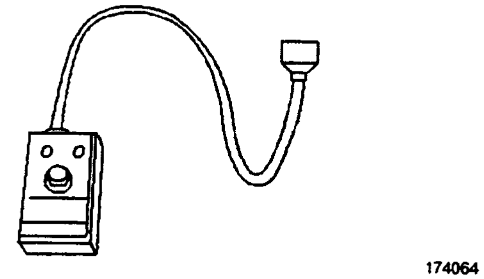
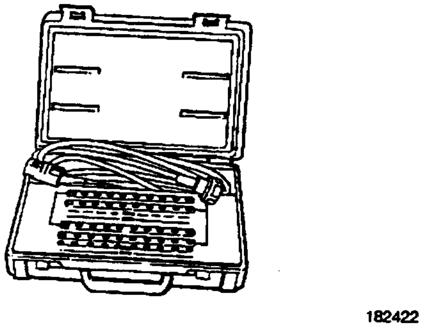
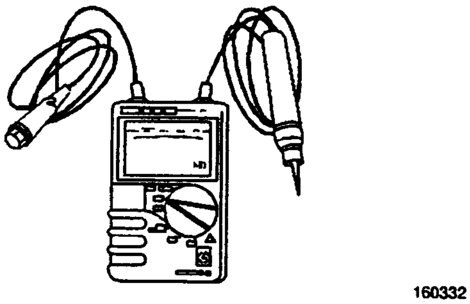
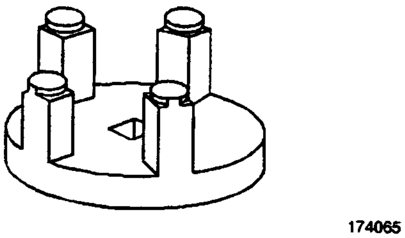
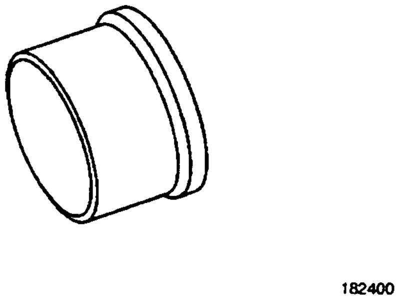
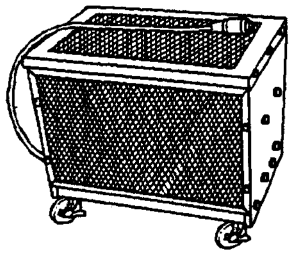
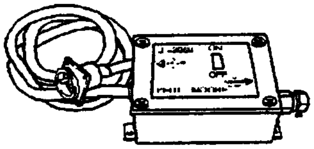
 174064	J 42241 Forward/Reverse Signal Generator
 182422	J 42494 Battery Pack Breakout Box
 160332	J 42502 Digital Insulation Tester
 174065	J 42495 Drive Motor Speed and Direction Sensor Removal Tool
 182400	J 42503 Cannon Connector Cover

Special Tools and Equipment

Illustration	Part No. /Description
 299356	J 42860-1 Battery Discharge tool
 299358	J 42860-2 Battery discharge tester

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SECTION 6B

PROPULSION SYSTEM COOLING

GENERAL DESCRIPTION

COOLING SYSTEM

NOTICE: ***At no time can pressure in the system exceed 10 psi or damage to the power inverter module will result.***

NOTICE: ***When adding coolant, it is important that you use Texaco Havoline® ELECTRA-COOL™ (i.e. GM P/N 27002485). Use of any other coolant may cause premature propulsion system component or radiator corrosion and damage the coolant pump.***

NOTICE: ***Texaco Havoline® ELECTRA-COOL™ is prediluted 50/50. Use of coolant diluted more than 50/50 may damage the cooling system.***

The S-10 Electric truck has a non-pressure propulsion system cooling system with temperature sensor control of the coolant circulation. The cooling system is sealed by a radiator cap, which has no pressure valve, that allows the system to operate at normal atmospheric pressure as there is no significant build-up of heat.

The cooling system provides coolant to the charge receptacle, the Power Inverter Module (PIM), the drive motor, and the radiator. A 12-volt coolant pump keeps the coolant circulating to all components during vehicle operation or during battery pack charging to prevent excess heat build-up.

The system is filled at the reservoir. Coolant can be sucked into the system; however, coolant is not allowed to expand and pass from radiator to reservoir through the radiator cap pressure valve as in other cooling systems.

RADIATOR COOLANT RESERVOIR

CAUTION: Do not remove surge tank cap to check engine coolant level; check coolant visually at the see-through surge tank only when the system cools.

A see-through plastic reservoir, similar to the familiar windshield washer reservoir, is connected to the radiator by a hose. Coolant should be added to the cooling system through this reservoir. The ccolant is drawn from the reservoir into the cooling system by vacuum, thus, the radiator is kept filled with coolant to the desired level at all times, resulting in increased cooling efficiency.

Keep the coolant level between the ADD and FULL marks on the recovery reservoir. These marks are about one liter (one quart) apart. Use Texaco Havoline® ELECTRA-COOL™ to keep the system at the FULL mark when hot.

PROPULSION SYSTEM COOLANT

This vehicle has a newly developed propulsion system coolant. Texaco Havoline® ELECTRA-COOL™ was developed to last 166,000 km (100,000 miles) or 5 years whichever occurs first. It has excellent heat transfer properties and provides high-temperature aluminum protection. Follow the instructions in Draining and Filling the Cooling System in this section. Make sure only Texaco Havoline® ELECTRA-COOL™ is added when coolant is added or changed.

Using Texaco Havoline® ELECTRA-COOL™ will provide the following protection:

- Give freezing protection down to -37 degrees C (-34 degrees F).
- Give boiling protection up to 108 degrees C (228 degrees F).
- Protect against rust and corrosion.
- Help keep the proper propulsion system temperature.
- Let the warning lights and gauges work as they should.

NOTICE: ***Antifreeze can be added to raise the boiling point of the coolant, but too much will affect the freezing point. Do not use a solution stronger than 70 percent antifreeze, as the freeze level rises rapidly after this point. Pure antifreeze will freeze at -22 degrees C (-8 degrees F).***

RADIATOR

The radiator is a cross-flow, tube, and center type, utilizing an aluminum core with plastic side tanks.

All radiators are fitted with a shroud designed to assist the fan in directing airflow through the radiator core and also serve as a fan guard. Provision for coolant expansion is achieved with a coolant recovery tank. This retards coolant overflow and reduces frequent refills.

COOLANT PUMP

The 12-volt coolant pump is of the centrifugal impeller type. The coolant pump has enclosed type ball bearings and is sealed with balance type mechanical seals for maximum durability.

DIAGNOSIS OF ENGINE COOLING

SYSTEM CHECKS

Coolant Pump

Check coolant pump operation by turning the key to the RUN position. The pump will circulate the coolant which can be felt through the coolant hose.

Radiator

Test for restrictions in the radiator by running the vehicle and then turning the vehicle off and feeling the radiator. The radiator should be hot along the left side and warm along the right side, with an even temperature rise from right to left. Cold spots in the radiator indicate clogged sections.

Looseness

Check a loose cooling fan assembly for wear and replace as necessary. Under various temperature conditions, there is a visible lateral movement at the tip of the fan blade. Approximately 6.5 mm (1/4 inch) maximum lateral movement measured at the fan tip is allowable. This is not a cause for replacement.

COOLANT DIAGNOSIS

Hydrometer

Due to changes in commercially available antifreeze, the use of a hydrometer may give an incorrect reading. The hydrometer should be used to test ethylene glycol base antifreeze only. Ethylene glycol base antifreeze is recommended for year-round use.

Coolant Tester

Coolant testers J 26568 (Centigrade Scale) and J 23688 (Fahrenheit Scale) can be used to check the antifreeze protection of the coolant. Make sure the hydrometer readings are correct. Unless J 26568 or J 23688 has a provision for temperature correction, test the temperature at which J 26568 or J 23688 is calibrated. If the coolant is warmer or cooler, the reading may be incorrect. Follow the manufacturer's directions for using J 26568 or J 23688.

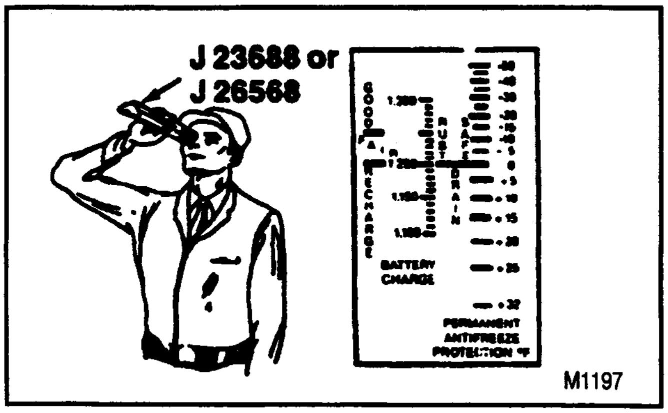


Figure 1—Coolant Tester

Cleaning

1. Before each use, swing back the plastic cover at the slanted end of J 26568 or J 23688, exposing the measuring window and bottom of the plastic cover.
2. Wipe dry with tissue or clean soft cloth.
3. Close the plastic cover.

Testing

Tools Required:
J 26568 (Centigrade Scale)
J 23688 Coolant Tester (Fahrenheit Scale)

1. Do not remove the clear plastic pump from the tester.
2. Release the tip of the pump from J 26568 or J 23688.
3. Insert the tip of the pump into the radiator filler neck.
   - A. Make sure the tip of the pump is below the level of the coolant.
   - B. Press and release the bulb to draw a sample.
   - C. Insert the tip of the pump into the cover plate opening.
   - D. Press the bulb and inject a few drops of coolant onto the measuring surface.
   - E. Do not open the plastic cover when taking readings because water evaporation can change the reading.

Reading

- Point J 26568 or J 23688 toward any light source and look into the eyepiece.
  - A. Coolant protection reading is at the point where the dividing line between light and dark crosses the scale (antifreeze protection is the scale on the right).
  - B. Temperature scale is reversed from a standard thermometer scale.
  - C. Below zero readings are on the upper half of the scale.
  - D. Readings on the lower half of the scale indicate solutions without enough antifreeze concentration to provide adequate rust protection.
  - E. If the readings are not clear, the measuring surfaces were not cleaned and dried properly. Wipe dry and make a new test.

COOLING SYSTEM DIAGNOSIS

PROBLEM	PROBABLE CAUSE	CORRECTION
Propulsion System Overheats or Temperature Indicator Lamp Illuminates.	1. Loss of coolant. 2. Low coolant protection. 3. Radiator fins obstructed. 4. Cooling system fins blocked by rust or scale. 5. Reservoir hose pinched or kinked. 6. Cooling fan inoperative. 7. Loose, damaged, and/or missing deflector. 8. Faulty coolant pump. 9. Incorrect radiator/	1. Refer to Loss of Coolant condition. 2. Solution should be -37° C (-34° F). Correct as necessary. 3. Remove or relocate add-on parts that obstruct radiator. Remove bugs, leaves, or debris from radiator fins. 4. Drain and flush the system. Repair as necessary. 5. Ensure that hose is properly routed or replace hose if necessary. 6. Refer to Electrical. 7. Repair or replace as necessary. 8. Replace coolant pump. 9. Install correct radiator.
Loss of Coolant.	1. Leaking radiator. 2. Faulty cooling system pressure cap. 3. Leaking coolant reservoir or hose. 4. Loose or damaged hoses or connections.	1. Repair or replace as necessary. 2. Replace cap. 3. Replace reservoir or hose as necessary. 4. Repair or replace hose or clamp as necessary.

UNCOMMON COOLING SYSTEM PROBLEMS

Problems Not Requiring Disassembly of the Cooling System

- Remove large obstructions blocking the radiator or condenser.
  - —License plates.
  - —Spare tires.
  - —Ice, mud, or snow obstructing the grille.
- Incorrect radiator for the application.
  - —Check the part number.
- Loose, damaged, or missing air seals.
- Missing or damaged lower air baffle.

Problems Requiring Disassembly of the Cooling System

- Incorrect or damaged fan.
- Worn or damaged coolant pump.
  - — Impeller vanes eroded or broken.
  - — Worn or damaged bearing and/or seal. Check for shaft or bearing play.
- Plugged radiator tubes.
  - — Perform a flow check.
- Internal component system leaks.
  - — PIM
  - — Drive Motor
  - — Charge Receptacle
  - — Damaged Hose assembly

ON-VEHICLE SERVICE

DRAINING AND FILLING THE COOLING SYSTEM

CAUTION: As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling point of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while the engine is hot and pressure is high will cause the solution to boil instantaneously - possibly with explosive force - spewing the solution over engine, fenders and person removing cap. Under some conditions, the ethylene glycol in coolant is combustible.

Draining

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Remove the fuel-fired heater coolant reservoir from the mounting bracket and set aside. Refer to Heater, Ventilation, and Air Conditioning.
3. Place a drain pan under the radiator drain cock.
4. Install a tube on the drain cock.
5. Place the end of the tube in the drain pan.

CAUTION: The radiator cap should be removed from a cool system only. If the radiator cap is removed from a hot cooling system, serious personal injury may result.

6. Make sure the cooling system is cool, then remove the radiator cap.
7. Open the drain cock completely.
8. Let the cooling system drain until the flow stops.
9. Close the radiator drain cock.

Filling

1. Make sure the radiator drain cock is closed.
2. Place a large top funnel in the radiator fill hole.
3. Slowly pour in the coolant. The coolant system holds 3.36 liters total.
4. After the cooling system is filled to 12.5 mm (1/2 in) below the fill hole, start the system and let the coolant pump circulate the coolant. As the coolant level drops, add coolant until the level is up to the fill hole.
5. Replace the radiator cap.
6. Check the coolant level in the recovery tank. Add coolant if needed.
7. Install the fuel-fired heater coolant reservoir to the mounting bracket. Refer to Heater, Ventilation, and Air Conditioning.
8. Install the high-voltage disconnect. Refer to Battery Pack Controls.

FLUSHING THE COOLING SYSTEM

Various methods and equipment can be used to flush the cooling system. If special equipment such as a back flusher is used, follow the equipment manufacturer's instructions. Under no circumstances can the equipment exceed 10 psi or internal damage to components will result.

NOTICE: ***If a component is damaged internally and a new component is installed in the vehicle, make sure all foreign material is completely flushed out of the cooling system. Failure to rid the cooling system of debris can result in damage to the replacement component.***

Important

- Remove the thermostat before flushing the cooling system.

RADIATOR COOLANT RESERVOIR REPLACEMENT

Remove or Disconnect (Figure 2)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Remove the spring clamps retaining two upper hoses to the reservoir.
3. Remove the hoses from the reservoir and set aside.
4. Remove the auxiliary battery from vehicle. Refer to Auxiliary Battery.

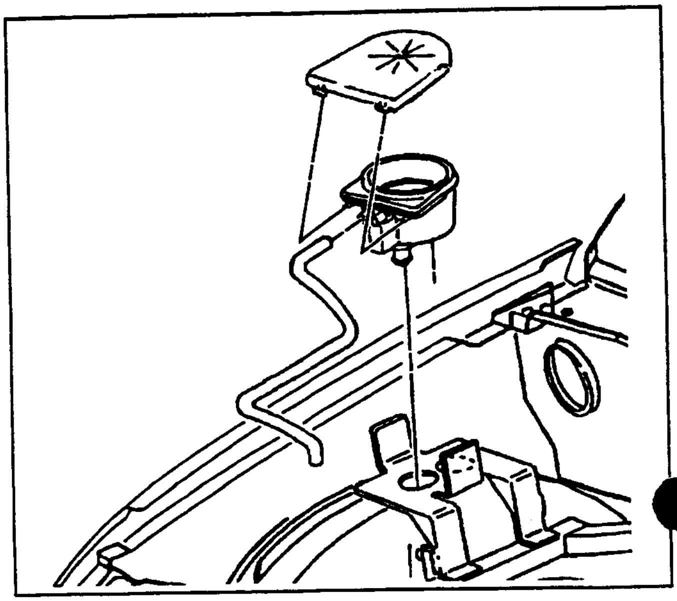


Figure 2—Radiator Coolant Reservoir

5. Remove the spring clamp retaining the oultet hose at the base of the reservoir.
6. Remove the reservoir from the vehicle by unsnapping two spring clips.
7. Remove the hose at the base of the reservoir.
8. Remove the reservoir from the vehicle.

Install or Connect (Figure 2)

1. Install the hose to the base of the reservoir.
2. Install the reservoir to the vehicle.
3. Install the reservoir to the vehicle by snapping into place.
4. Install the spring clamp retaining the outlet hose at the base of the reservoir.
5. Install the auxiliary battery to the vehicle. Refer to Auxiliary Battery.
6. Two upper hoses to the reservoir.
7. Install the high-voltage disconnect. Refer to Battery Pack Controls.
8. Fill the reservoir tank to the proper level with Texaco Havoline® ELECTRA-COOL ™ .

COOLANT HOSES

Power Inverter Module Outlet Hose Replacement

Remove or Disconnect (Figure 3)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Remove the fuel-fired heater coolant reservoir from the mounting bracket and set aside. Refer to Heater, Ventilation, and Air Conditioning.
3. Open the radiator drain cock.
4. Drain coolant into a clean pan. Refer to Draining and Filling the Cooling System in this Section.
5. Remove the hose from the right-hand side of the Power Inverter Module (PIM).
6. Remove the hose from coolant reservoir at the tee fitting.
7. Raise the vehicle.
8. Remove the hose from the drive motor.

Install or Connect (Figure 3)

1. Install the hose to the drive motor.
2. Lower the vehicle.
3. Install the hose to the right-hand side of the power electronics bay.
4. Install the hose from the coolant reservoir to the tee fitting.
5. Install the fuel-fired heater coolant reservoir to it's mounting bracket. Refer to Heater, Ventilation, and Air Conditioning.

Tighten

- Tighten heater coolant reservoir mounting screws to 1.9 N·m (17 lb in)

6. Install the high-voltage disconnect. Refer to Battery Pack Controls.
7. Fill the coolant system. Refer to Draining and Filling the Cooling System in this Section.

Radiator Reservoir Recovery Hose Replacement

Remove or Disconnect (Figure 3)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Remove the recovery hose from the tee fitting.
3. Drain coolant into a clean pan. Refer to Draining and Filling the Cooling System in this Section.
4. Remove the recovery hose from the coolant reservoir.

Install or Connect (Figure 3)

1. Install the recovery hose to the tee fitting.
2. Install the recovery hose to the coolant reservoir.
3. Fill the coolant system. Refer to Draining and Filling the Cooling System in this Section.
4. Install the high-voltage disconnect. Refer to Battery Pack Controls.

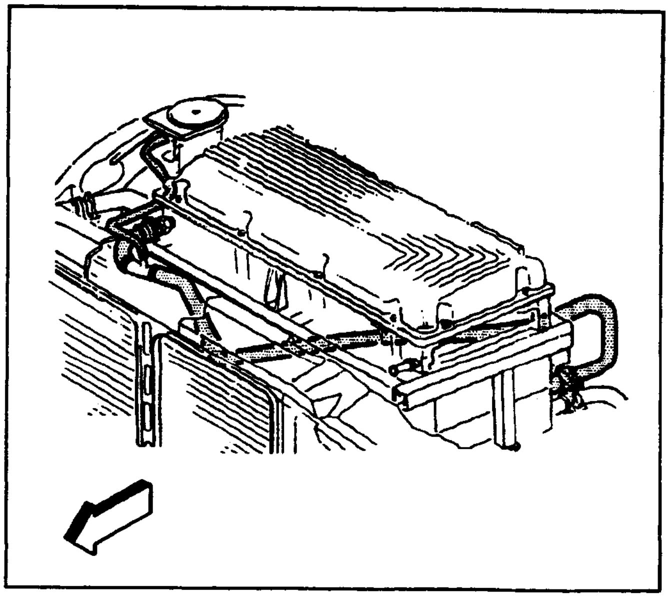


Figure 3—PIM Outlet Hose

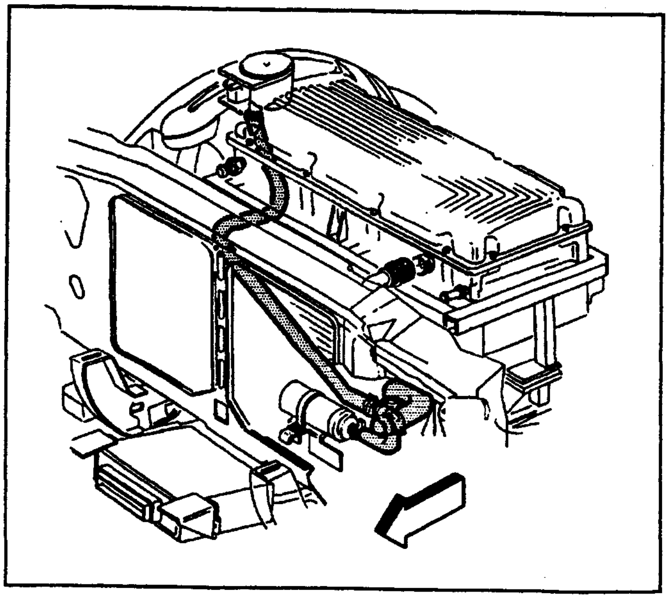


Figure 4—Radiator Reservoir Outlet Hose

Radiator Reservoir Outlet Hose Replacement

Remove or Disconnect (Figure 4)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Remove the fuel-fired heater coolant reservoir from the mounting bracket and set aside. Refer to Heater, Ventilation, and Air Conditioning.
3. Open the radiator drain cock.
4. Drain coolant into a clean pan. Refer to Draining and Filling the Cooling System in this Section.
5. Remove the auxiliary battery cables. Refer to Auxiliary Battery.
6. Remove the radiator coolant reservoir. Refer to Radiator Coolant Reservoir Replacement in this section.
7. Remove the reservoir outlet hose from the bottom of the radiator coolant reservoir.
8. Remove the reservoir outlet hose from the tee fitting.

Install or Connect (Figure 4)

1. Install the reservoir outlet hose to the tee fitting.
2. Install the reservoir outlet hose to the bottom of the radiator coolant reservoir.
3. Install the radiator coolant reservoir. Refer to Radiator Coolant Reservoir Replacement in this section.
4. Install the auxiliary battery cables. Refer to Auxiliary Battery.
5. Install the fuel-fired heater coolant reservoir to its mounting bracket. Refer to Heater, Ventilation, and Air Conditioning.
6. Install the high-voltage disconnect. Refer to Battery Pack Controls.
7. Fill the coolant system. Refer to Draining and Filling the Cooling System in this Section.

Radiator Vent Outlet Hose Replacement

Remove or Disconnect (Figure 5)

1. Remove the vent outlet hose and clamp from the reservoir.
2. Remove two P-clips retaining the vent outlet hose from the upper shroud plate.
3. Remove the vent outlet hose and clamp from the radiator.

Install or Connect (Figure 5)

1. Install the vent outlet hose and clamp to the reservoir.
2. Install two P-clips retaining the vent outlet hose to the upper shroud plate.
3. Install the vent outlet hose and clamp to the radiator.

Charge Receptacle Outlet Hose Replacement

Remove or Disconnect (Figures 6 and 7)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.

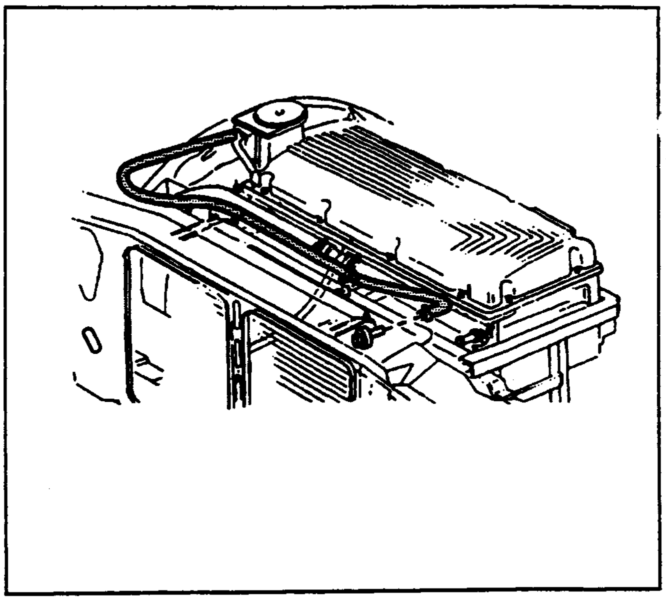


Figure 5—Radiator Vent Outlet Hose

2. Drain the coolant system. Refer to Draining and Filling the Cooling System in this section.
3. Remove the hose from the tee in the radiator hose (Figure 7).
4. Remove the air deflector panel from the bottom of the vehicle. Refer to Sheet Metal.
5. Remove the hose from the charge receptacle.

Install or Connect (Figures 6 and 7)

1. Install the hose to the charge receptacle.
2. Install the hose to the tee in the radiator hose (Figure 7).
3. Install the air deflector panel to the bottom of the vehicle. Refer to Sheet Metal.
4. Fill the coolant system. Refer to Draining and Filling the Cooling System in this section.
5. Install the high-voltage disconnect. Refer to Battery Pack Controls.

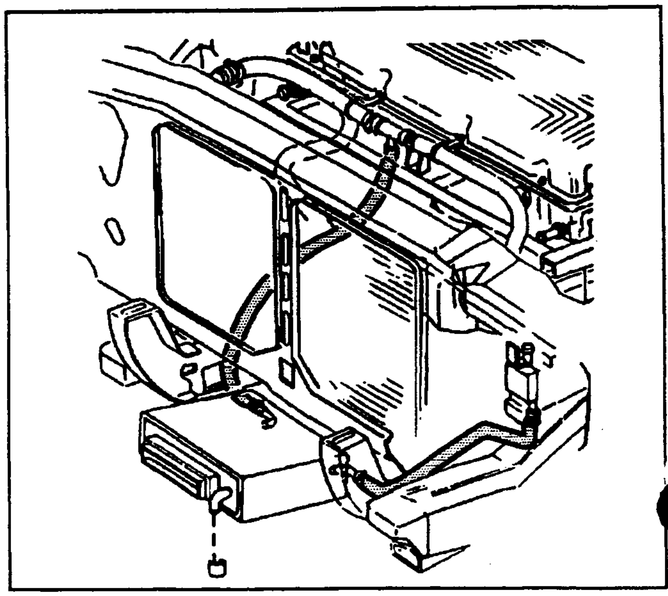


Figure 6—Charge Receptacle Inlet/Outlet Hose

Charge Receptacle Inlet Hose Replacement

Remove or Disconnect (Figure 6)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Remove the fuel-fired heater coolant reservoir from the mounting bracket and set aside. Refer to Heater, Ventilation, and Air Conditioning.
3. Drain the coolant system. Refer toDraining and Filling the Cooling System in this section.
4. Remove the hose from the coolant valve.
5. Remove the air deflector panel from the bottom of the vehicle. Refer to Sheet Metal.
6. Remove the hose from the charge receptacle.

Install or Connect (Figure 6)

1. Install the hose to the charge receptacle.
2. Install the hose to the coolant valve.
3. Install the air deflector panel to the bottom of the vehicle. Refer to Sheet Metal.
4. Fill the coolant system. Refer to Draining and Filling the Cooling System in this section.
5. Install the fuel-fired heater coolant reservoir to its mounting bracket. Refer to Heater, Ventilation, and Air Conditioning.
6. Install the high-voltage disconnect. Refer to Battery Pack Controls.

Radiator Inlet Return Hose Replacement

Remove or Disconnect (Figures 7 and 8)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Drain the coolant system. Refer to Draining and Filling the Cooling System in this section.
3. Remove the hose from the radiator.
4. Remove the two hose straps securing the hose to the PIM. Refer to Figure 9.
5. Remove the hose from the charge receptacle hose at the tee. Refer to Figure 9.
6. Raise the vehicle on a hoist.
7. Remove the hose from the drive motor.

Install or Connect (Figures 7 and 8)

1. Position hose under the PIM subframe.
2. Install the hose to the drive motor.
3. Lower the vehicle on the hoist.
4. Install the charge receptacle hose to the radiator hose at the tee (Figure 9).
5. Install the hose to the radiator.
6. Install two hose straps securing the hose to the PIM (Figure 9).
7. Fill the coolant system. Refer to Draining and Filling the Cooling System in this section.
8. Install the high-voltage disconnect. Refer to Battery Pack Controls.

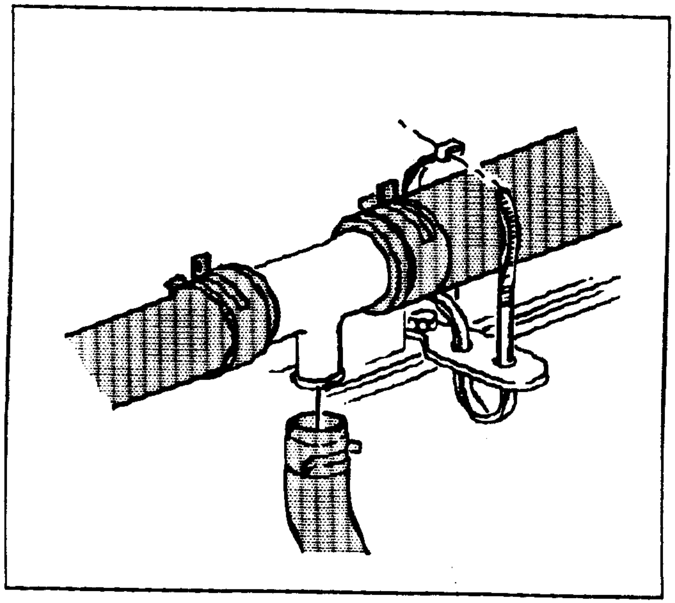


Figure 7—Charge Receptacle Outlet Hose Tee Connection

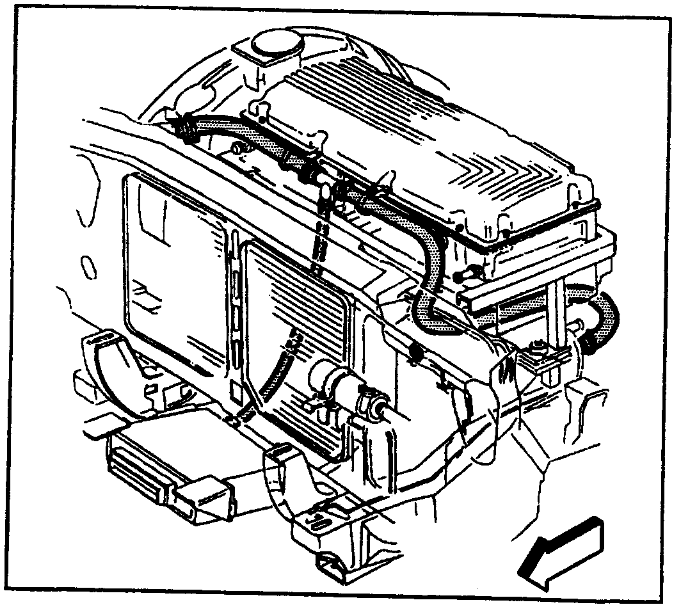


Figure 8—Radiator Inlet Return Hose

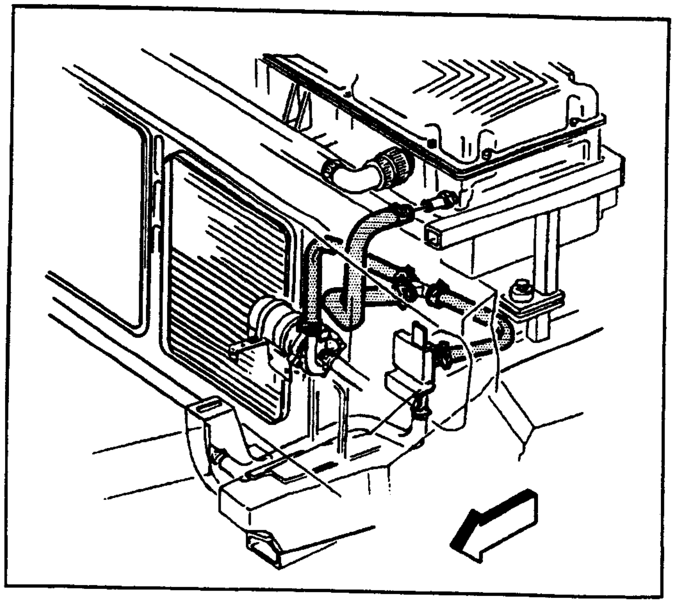


Figure 9—Coolant Pump Outlet Hose

Coolant Pump Outlet Hose Replacement

Remove or Disconnect (Figure 9)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Drain the coolant system. Refer to Draining and Filling the Cooling System in this section.
3. Remove the hose from the cooling valve.
4. Raise the vehicle on a hoist.
5. Remove the air deflector panel from the bottom of the vehicle. Refer to Sheet Metal.
6. Remove the PIM hose at the tee connector.
7. Remove the hose from the coolant pump.

Install or Connect (Figure 9)

1. Install the hose to the coolant pump.
2. Install the PIM hose to the pump outlet hose at the tee.
3. Install the air deflector panel to the bottom of the vehicle. Refer to Sheet Metal.
4. Lower the vehicle on the hoist.
5. Install the hose to the coolant valve.
6. Fill the coolant system. Refer to Draining and Filling the Cooling System in this section.
7. Install the high-voltage disconnect. Refer to Battery Pack Controls.

Coolant Pump Inlet Hose Replacement

Remove or Disconnect (Figure 10)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Drain the coolant system. Refer to Draining and Filling the Cooling System in this section.
3. Remove the hose from the lower radiator.
4. Raise the vehicle on a hoist.
5. Remove the air deflector panel from the bottom of the vehicle. Refer to Sheet Metal.
6. Remove the reservoir hose at the tee connector.
7. Remove the hose from the coolant pump.

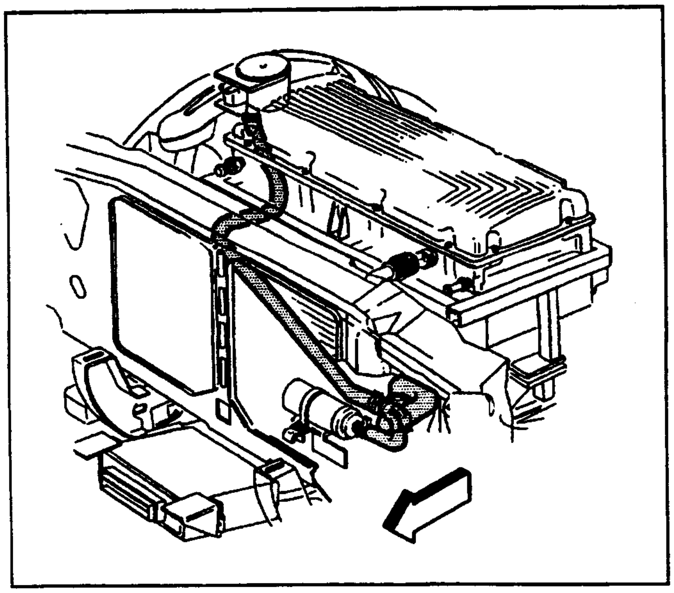


Figure 10—Coolant Pump Inlet Hose

Install or Connect (Figure 10)

1. Install the hose to the coolant pump.
2. Install the reservoir hose to the pump outlet hose at the tee.
3. Install the air deflector panel to the bottom of the vehicle. Refer to Sheet Metal.
4. Lower the vehicle on the hoist.
5. Install the hose to the lower radiator.
6. Fill the coolant system. Refer to Draining and Filling the Cooling System in this section.
7. Install the high-voltage disconnect. Refer to Battery Pack Controls.

Power Inverter Module Inlet Hose Replacement

Remove or Disconnect (Figure 11)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Drain the coolant system. Refer to Draining and Filling the Cooling System in this section.
3. Remove the hose from the PIM.
4. Raise the vehicle on a hoist.
5. Remove the air deflector panel from the bottom of the vehicle. Refer to Sheet Metal.
6. Remove the pump hose at the tee connector.
7. Remove the hose from the coolant pump.

Install or Connect (Figure 11)

1. Install the hose to the coolant pump.
2. Install the pump hose at the tee.
3. Install the air deflector panel to the bottom of the vehicle. Refer to Sheet Metal.
4. Lower the vehicle on the hoist.
5. Install the hose to the PIM.
6. Fill the coolant system. Refer to Draining and Filling the Cooling System in this section.
7. Install the high-voltage disconnect. Refer to Battery Pack Controls.

FAN REPLACEMENT

CAUTION: To help avoid personal injury or damage to the vehicle, a bent, cracked, or damaged fan blade or housing should always be replaced.

Remove or Disconnect (Figure 12)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Remove the Power Inverter Module (PIM). Refer to Drive Motor Controls.
3. Remove the PIM subframe. Refer to Frame and Bumpers.
4. Disconnect fan electrical harness to fan buffer pigtail.
5. Remove the fan retaining bolt from bottom of radiator.
6. Remove the fan by sliding the fan tabs from radiator retaining clips.

CAUTION: Do not use or repair a damaged fan assembly. An unbalanced fan assembly could fly apart and cause personal injury and/or property damage. Replace damaged assemblies with new assemblies.

Install or Connect (Figure 12)

1. Install the fan to radiator by sliding the fan tabs into radiator retaining clips.
2. Install the fan retaining bolt in bottom of radiator.

Tighten

- Tighten the fan retaining bolt to 10 N.m (88 lb in).

3. Connect the fan electrical harness to the fan buffer pigtail.

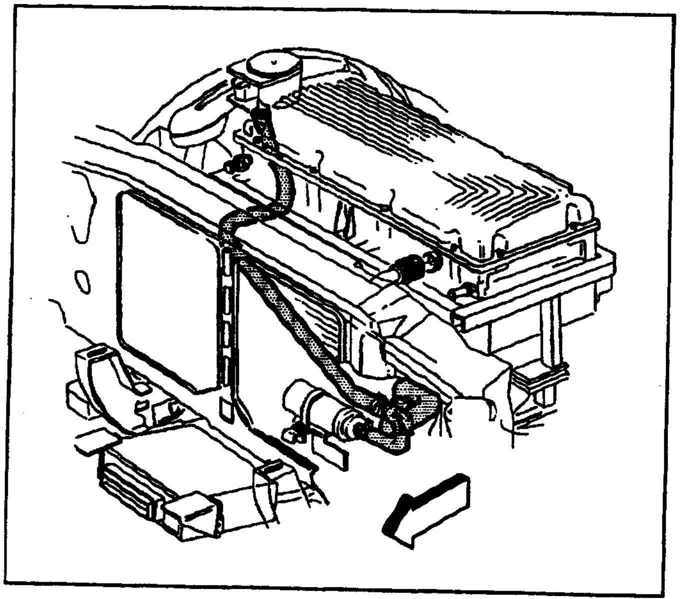


Figure 11—Power Inverter Module Inlet Hose

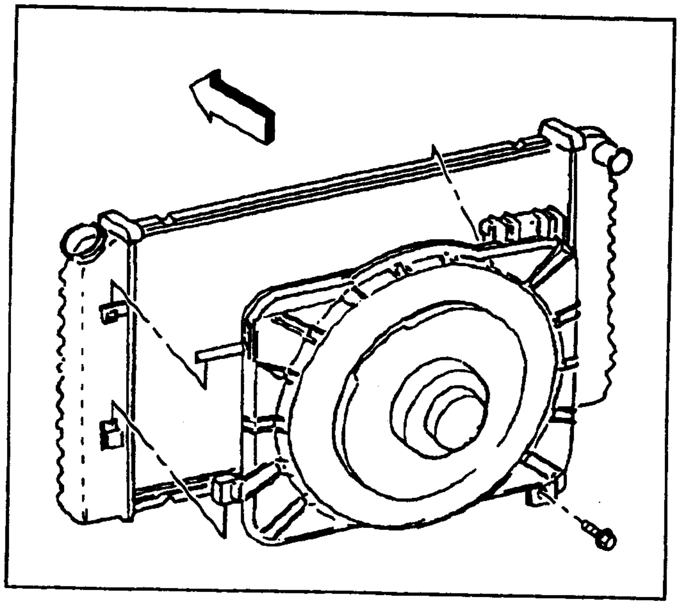


Figure 12—Cooling Fan Installation

4. Install the PIM subframe. Refer to Frame and Bumpers.
5. Install the Power Inverter Module (PIM). Refer to Drive Motor Controls.
6. Install the high-voltage disconnect. Refer to Battery Pack Controls.

COOLANT PUMP BUFFER REPLACEMENT

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Raise the vehicle.
3. Remove the air deflector panel. Refer to Sheet Metal.
4. Disconnect the electrical connectors at the buffer pigtails.
5. Remove two screws retaining the buffer to the frame (Figure 13).
6. Remove the buffer.

Install or Connect (Figure 13)

1. Install buffer to the frame.
2. Install two coolant pump buffer screws to buffer and frame.

Tighten

- Tighten cooling pump buffer screw to 4 N.m (35 lb in)

3. Connect the electrical connectors.
4. Install the air deflector panel. Refer to Sheet Metal.
5. Lower the vehicle.
6. Install the high-voltage disconnect. Refer to Battery Pack Controls.

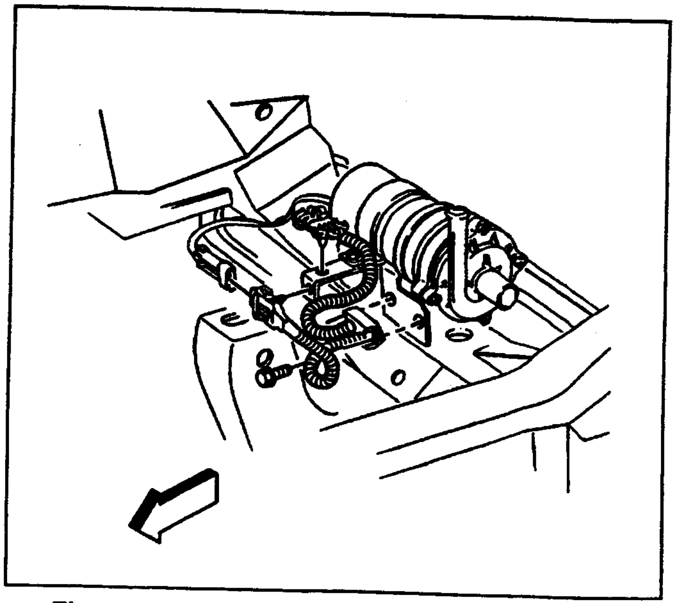


Figure 13—Coolant Pump Buffer Attachment

COOLANT PUMP REPLACEMENT

Remove or Disconnect (Figure 14)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Remove the fuel-fired heater coolant reservoir from the mounting bracket and set aside. Refer to Heater, Ventilation, and Air Conditioning.
3. Open the radiator drain cock.
4. Drain coolant into a clean pan.
5. Close the radiator drain cock.
6. Raise the vehicle on hoist.
7. Remove the Air Deflector Panel. Refer to Sheet Metal.
8. Disconnect the electrical connector from the coolant pump.
9. Disconnect the coolant inlet hose from the right-hand side of the pump.
10. Disconnect the coolant outlet hose from the top of the pump.
11. Remove the screw and strap from the pump.
12. Remove the pump.

Install or Connect (Figure 14)

1. Install pump on bracket.
2. Install strap and screw to pump.

Tighten

- Tighten screw to 12 N·m (106 lb in)

3. Connect coolant outlet hose to the top of the pump.
4. Connect coolant inlet hose to the right hand side of the pump.
5. Connect the electrical connector to the coolant pump.
6. Install the Air Deflector Panel. Refer to Sheet Metal.
7. Lower vehicle on hoist.
8. Install the fuel-fired heater coolant reservoir to it's mounting bracket. Refer to Heater, Ventilation, and Air Conditioning.
9. Install the high-voltage disconnect. Refer to Battery Pack Controls.
10. Fill the coolant system. Refer to Draining and Filling the Cooling System in this section.

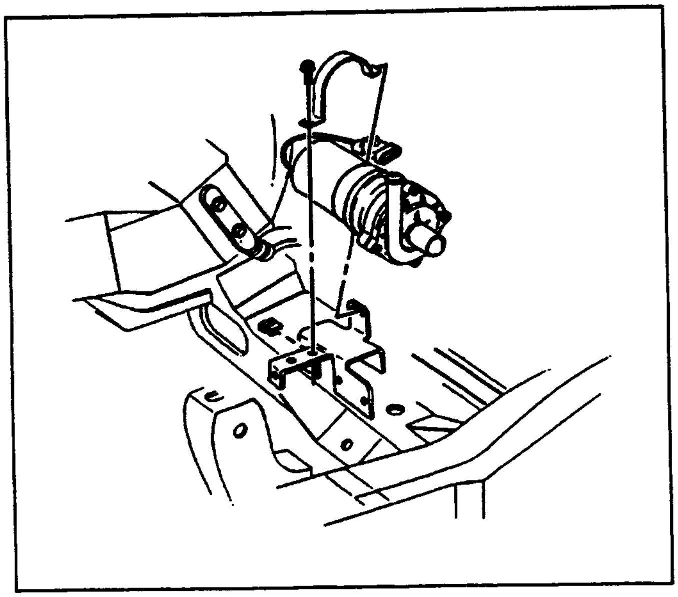


Figure 14—Coolant Pump

DRAIN COCK REPLACEMENT

Remove or Disconnect (Figure 15)

1. Raise vehicle on hoist.
2. Remove the Air Deflector Panel. Refer to Sheet Metal.
3. Drain the coolant system. Refer to Draining and Filling the Cooling System in this section.
4. Remove the drain cock.
5. Remove the seal.
6. Remove the body.

Inspect

- Drain cock, seal, and body for cracks or damage.

Install or Connect (Figure 15)

1. Install the body.
2. Install the seal.
3. Install the drain cock.
4. Install the Air Deflector Panel. Refer to Sheet Metal.
5. Lower the vehicle.
6. Fill the coolant system. Refer to Draining and Filling the Cooling System in this section.

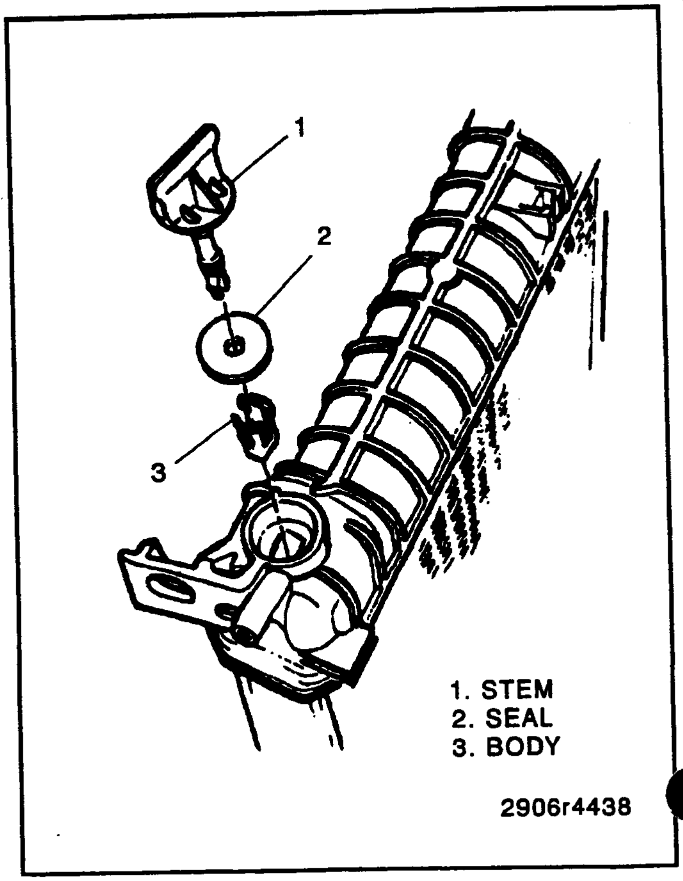


Figure 15—Drain Cock

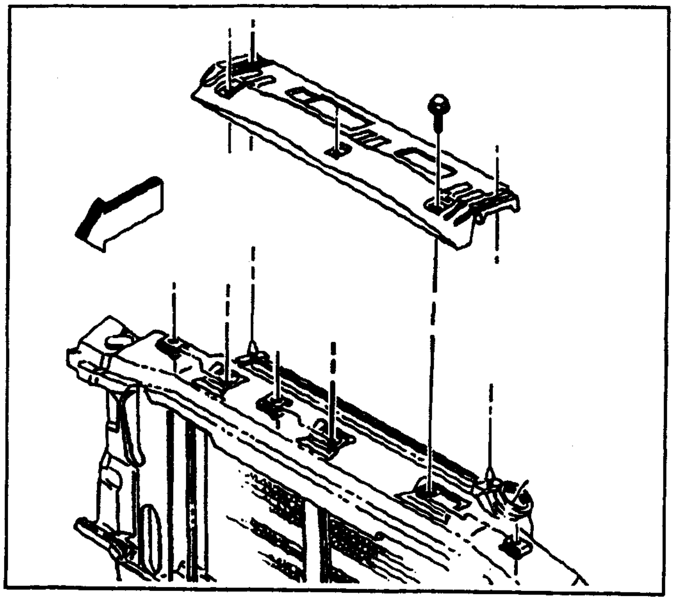


Figure 16—Upper Shroud Plate

UPPER SHROUD PLATE REPLACEMENT

Remove or Disconnect (Figure 16)

1. Remove two coolant hose P-clips from the upper shroud plate.
2. Remove three bolts from the upper shroud plate.
3. Remove the upper shroud plate.

Install or Connect (Figure 16)

1. Upper shroud plate with three bolts.

   Tighten

   - Tighten upper shroud plate bolts to 6.5 N·m (57 lb in).
2. Install coolant hose to the upper shroud plate with two P-clips.

RADIATOR REPLACEMENT

Remove or Disconnect (Figure 17)

1. Drain the coolant from radiator. Refer to Draining and Filling the Cooling System in this section.
2. Disconnect the coolant reservoir hose.

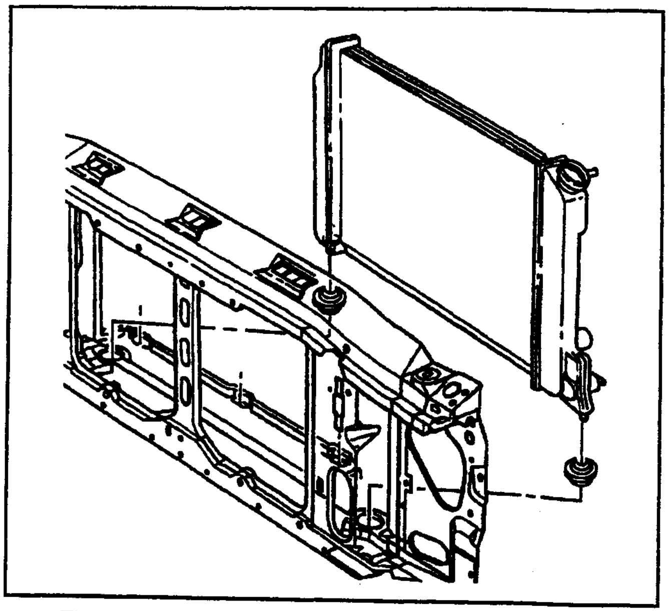


Figure 17—Radiator Mounting Components

3. Remove the upper fan shroud. Refer to Fan Shroud Replacement in this section.
4. Disconnect the hoses.
5. Disconnect the transmission fluid cooler lines.
6. Remove the radiator.
7. Remove the lower fan shroud. Refer to Fan Shroud Replacement in this section.

Inspect

- All parts and connections for leaks and wear. Replace if necessary.

Install or Connect (Figure 17)

1. Install the lower fan shroud. Refer to Fan Shroud Replacement in this section.
2. Install the radiator.
3. Connect the transmission fluid cooler line nuts.

   Tighten

   - Cooler line nuts to 24 N·m (18 lb ft).
4. Connect hoses.
5. Install the upper fan shroud.
6. Connect the coolant reservoir hose.
7. Fill the coolant system. Refer to Draining and Filling the Cooling System in this section.

MAINTENANCE RECOMMENDATIONS

CAUTION: Never spray water on a hot radiator. The resulting steam could cause personal injury.

NOTICE: ***Compressed air or water can be used to clean radiator fins. Do not exceed 138 kPa (20 psi). Pressures over 138 kPa (20 psi) will damage the radiator.***

Check the outside of the radiator for excessive bent fins or signs of leakage. If present, replace radiator. Refer to Radiator Replacement in this section.

Do not seal temporarily with a sealer type antifreeze or coolant additive. Remove any stones between the fins. Clean loose debris and road film from the radiator core with a quality grease solvent and compressed air. Direct the stream of solvent at the front of the core for more efficient cleaning.

Remove the grille, fan guard, and fan shroud to ensure a thorough cleaning.

Remove the radiator cap and look for plugging and scale on the inside of the tank. Replace a badly plugged radiator. Test the radiator and system. Refer to Testing Procedures in this section.

NOTICE: ***Pressures above 69 kPa (10 psi) should not be used when testing the cooling system. Pressures over 69 kPa (10 psi) will damage the power inverter module.***

1. Check the coolant level. If low, add recommended coolant as required.
2. Check the hose condition and tighten the clamps if leakage is evident. Replace cracked, stripped, or corroded clamps.
3. Check the coolant hoses for spongy or cracked appearance. Replace deteriorated hoses or bursting could occur. This can result in coolant loss and may damage electrical connections.
4. Check the radiator core for leaks and accumulation of dirt that may obstruct the air passages and reduce heat transfer.
5. Check the surge tank or recovery tank for leaks. Plastic bottles may develop cracks from being damaged by flying objects. Metal tanks should be checked at the weld seams.
6. Inspect the radiator rubber mountings and bumpers for deterioration and replace as necessary. Check the mounting bolts, supports, braces, tie rods, and stabilizer rods. Components should be securely fastened in place if mounting bolts are missing, loose, or stripped. Also check for damage to core, side flanges, and supporting components.
7. Check for clearance between the fan blades, core, and shroud. Check the fan attaching bolts for tightness and make sure none are missing. Replace the fan if any blade is bent. The distance between the blades and shroud should be equal around the entire perimeter of the shroud. Adjust as necessary after any adjustment has been made to the fan or the fan mounting bracket and hub.
8. Inspect the filler cap seal for evidence of cracking, separation, or deterioration. Replace as required.
9. To assist in maintaining efficient heat dissipation, an occasional external flushing with water will remove the majority of dirt accumulation and foreign matter between the core fins. Direct water under moderate pressure from behind the core to force debris out in the opposite direction of its entry. Direct the water stream in line with the fins to reduce the possibility of bending fins.

RADIATOR INTERNAL DEPOSITS

A radiator with a dirty, obstructed, or leaking core will cause the coolant system to overheat. A scale deposit inside the radiator is a result of using hard, high mineral content water in the cooling system. The effect of heat on minerals in the water causes the formation of scale, or hard coating, on metal surfaces within the radiator. Scaling reduces the transfer of heat. Some hard water will produce a silt-like deposit that restricts the flow of water. Replace a radiator that is plugged or has a heavy scale on the core.

SCALE REMOVAL

To remove the hardened scale, a direct chemical action is necessary. A flushing compound at the specified rate of 30 grams per liter (4 oz. per gallon) of radiator capacity should be added to the coolant water in the form of a dissolved solution while the coolant pump is running. Operate the vehicle for 15 minutes, then drain and flush the system with clean water.

There are various types of flushing compounds commercially available, but they should be obtained from a reliable source. Most compounds attack metals and should not remain in the engine for more than a few minutes. Use a neutralizer in the cooling system immediately after a descaling solvent is used.

For extremely hard, stubborn coatings, such as lime scale, use a stronger solution. The corrosive action of a stronger solution will affect the thin metals of the radiator, thereby reducing its operating life. A complete flushing and rinsing is mandatory and must be accomplished skillfully.

After the solvent and neutralizer have been used and the cooling system is flushed, drain the system and fill it with only Texaco Havoline® ELECTRA-COOL ™ antifreez. After filling the cooling system, check for radiator, hose, and engine coolant leaks.

RADIATOR SERVICE

TESTING PROCEDURES

Leak Testing

Some core leaks can be detected by adding water to the radiator. Clean the core so the damaged area can be found.

1. Remove dirt and insects from the fins with a common water hose without a nozzle. Excessive water pressure could damage the fins.
2. Scrub the core with a soft-bristle brush using clean, hot water, or hot water with a mild detergent.

Off-Vehicle Leak Testing

NOTICE: ***Do not use boil-out tanks, vats, or other tanks that have been used for copper and brass radiators. The flux, acid, and caustic cleaners remaining in these tanks will attack the aluminum and cause radiator failure. Use a separate test tank containing clean water for servicing aluminum/plastic radiators.***

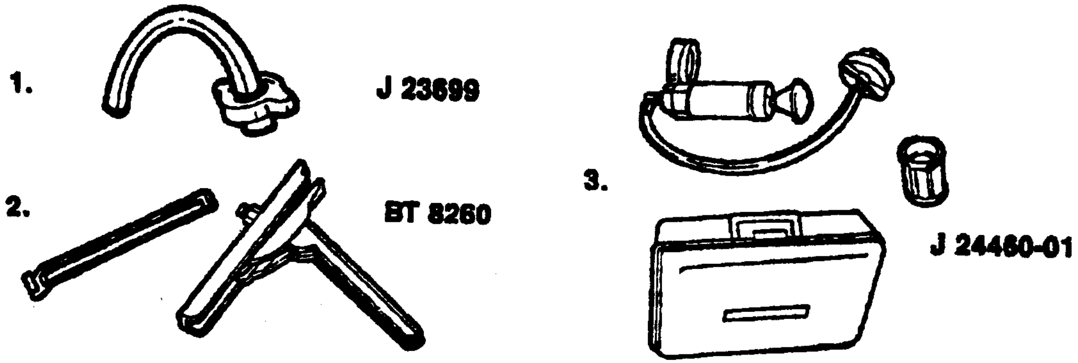
1. Install test fittings or rubber test caps in the inlet and outlet necks and seal the transmission and engine oil cooler fittings with metal plugs to protect the coolers and keep the fluid from running out.
2. Attach the pressure tester and gradually apply air pressure until 138 kPa (20 psi) is attained. Do not exceed 138 kPa (20 psi). Check the pressure gauge to see if there is a pressure loss. To ensure there are no small leaks, run water over the repair area and look for bubbles. (A mild detergent is helpful.) If a large water tank is available, submerge the radiator and check for air bubbles.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N·m	Lb ft	Lb in
Coolant Fan Retaining Bolt	10	—	88
Coolant Pump Strap Screw	12	—	106
Heater Coolant Reservoir Mounting Screw	1.9	—	17
Upper Shroud Plate Bolt	6.5	—	57

SPECIAL TOOLS



1. Overflow Tube Pressure Test Adapter
2. Radiator Core Remover/Installer
3. Cooling System Tester

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NOTES

SECTION 6D1

AUXILIARY BATTERY

GENERAL DESCRIPTION

BATTERY

The maintenance-free battery is standard in all vehicles (Figure 1). Refer to Specifications in this section for specific applications. The battery is completely sealed except for two small vent holes in the sides. These vent holes allow the small amount of gas produced in the battery to escape.

The battery has two functions in the electrical system: first, it provides a source of energy for the 12-volt electrical system and second, it acts as a voltage stabilizer for the electrical system.

The battery specification label contains information pertinent to the servicing of the battery (Figure 2). This information includes test ratings and both original equipment and recommended replacement part numbers. This information is also included in the specifications at the end of this section.

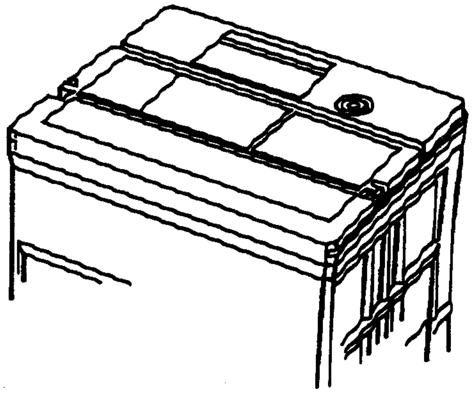
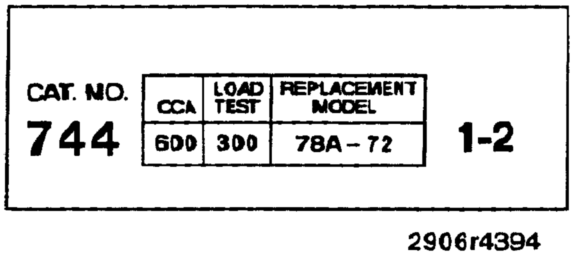


Figure 1—Maintenance-Free Battery



CAT. NO.

744

CCA	LOAD TEST	REPLACEMENT MODEL
600	300	78A-72

1-2

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Figure 2—Battery Label (Typical)

BATTERY RATINGS

A battery has two ratings: reserve capacity and cold cranking amperage.

Reserve Capacity

Reserve capacity is an estimate of how long the vehicle can be driven without electrical input, with the headlamps turned on, and minimum electrical load (most accessories turned off). It is the maximum amount of time (in minutes) it will take for a fully charged battery, being discharged at a constant rate of 25 amperes and a constant temperature of 27°C (80°F), to reach a terminal voltage of 10.5 volts. Other temperatures or current draws, the state of charge, the condition of the battery, etc., will affect how long the battery will actually last when the vehicle is being driven without electrical input.

Cold Cranking Amperage

Cold cranking amperage is an indication of the ability of the battery to crank the engine at cold temperatures. The capacity rating is the minimum amperage the battery must maintain for 30 seconds at -18°C (0°F), while maintaining at least 7.2 volts. The actual performance of a battery will vary with actual temperature, etc.

COMMON CAUSES OF FAILURE

The battery is not designed to last indefinitely; however, with proper care, it will provide many years of service.

If the battery tests good but fails to perform satisfactorily in service for no apparent reason, the following are some important factors that may point to the cause of trouble:

- Vehicle accessories left on overnight with the key turned OFF.
- The vehicle's electrical load is more than the Accessory Power Module (APM) input, particularly with the addition of aftermarket equipment.
- Battery abuse, including failure to keep battery cable terminals clean and tight or operating with a loose battery hold-down.
- Mechanical conditions in the electrical system, such as shorted or pinched wires, or a cracked battery case resulting from a collision.

The outside of the battery should be checked periodically for damage, such as a cracked cover or case.

ELECTROLYTE FREEZING

The freezing point of electrolyte depends on its specific gravity. Since freezing may ruin a battery, protect it against freezing by keeping it in a charged condition. As long as the green dot shows in the built-in hydrometer, the battery will not freeze unless the temperature drops below -32°C (-25°F). A fully charged battery will not freeze unless the temperature drops below -54°C (-65°F).

CARRIER AND HOLD-DOWN

The battery carrier and hold-down clamp should be clean and free from corrosion before installing the battery.

The carrier should be in sound condition so it will hold the battery securely and keep it level. Make certain there are no parts in the carrier before installing the battery.

To prevent the battery from shaking in its carrier, the hold-down bolts should be tightened to the specifications given at the end of this section.

BATTERY PROTECTION DURING VEHICLE STORAGE

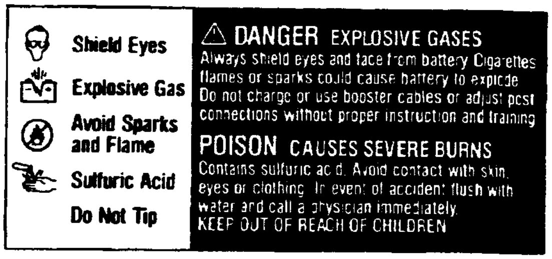
CAUTION: Follow all safety precautions. Refer to Figure 3.

Some electronic devices on the vehicle impose small continuous current drains on the battery; this is commonly called "parasitic load." If the vehicle is not used for an extended time, these parasitic loads can discharge and eventually cause permanent damage to the battery. Discharged batteries can also freeze in cold weather. Refer to Electrolyte Freezing in this Section.

NOTICE: ***Always turn off the ignition when connecting or disconnecting battery cables, battery chargers, or jumper cables. Failing to do so may damage the Drive Motor Control Module (DMCM), or other electronic components.***

To help keep the battery in a charged state while storing the vehicle:

- If the vehicle is likely to be stored for over 30 days, make sure the green dot is visible, then disconnect the negative battery cable at the battery. This will protect the battery from being discharged by parasitic current drains. When it is time to reconnect the battery:
  1. Use a wire brush to lightly clean any oxidation from the contact face of the battery terminal before reattaching the cable.
  2. Tighten the battery cable bolt to 15 N.m (11 lb ft).
  3. Reset the clock, pushbutton radio tuning, etc., before the vehicle is put back in service.



Shield Eyes

Explosive Gas

Avoid Sparks and Flame

Sulfuric Acid

Do Not Tip

⚠ DANGER EXPLOSIVE GASES

Always shield eyes and face from battery Cigarettes flames or sparks could cause battery to explode Do not charge or use booster cables or adjust post connections without proper instruction and training

POISON CAUSES SEVERE BURNS

Contains sulfuric acid. Avoid contact with skin, eyes or clothing. In event of accident flush with water and call a physician immediately.

KEEP OUT OF REACH OF CHILDREN

2906r4397

Figure 3—Safety Precautions

- If the battery cannot be disconnected, establish a regular schedule of recharging the battery every 20-45 days to maintain a high state of charge. Any time a battery is found with the green dot not visible in the hydrometer, promptly recharge the battery.
- To keep charge time low, use a battery charger that is capable of providing a charging voltage of at least 16 volts. Original equipment maintenance free batteries will not be damaged by charge rates of 50 amperes or more, as long as the battery does not spew acid from the vents or get hot over 52°C (125° F). Every 45-60 minutes, inspect the battery being charged and stop or reduce the charge rate if necessary. To avoid overcharging, make sure to stop charging within one hour after the green dot appears in the hydrometer.
- Allow ample charging time. Refer to Battery Charging in this Section.
- A battery that is allowed to remain in a discharged state for a long period of time will be difficult to recharge, and may even become permanently damaged if allowed to stay discharged.

BUILT-IN HYDROMETER

Molded into the top of the maintenance-free battery is a built-in temperature compensated hydrometer (Figure 4). Use this hydrometer with the following diagnostic procedure.

When observing the hydrometer, make sure that the battery has a clean top. A light may be required in some poorly-lit areas.

Under normal operation, one of three indications can be observed:

1. GREEN DOT VISIBLE
   - Any green appearance in the hydrometer is interpreted as a "green dot." This means the battery is ready for testing.
2. GREEN DOT NOT VISIBLE
   - If the green dot cannot be seen and there is a power up complaint, proceed to "Diagnosis of the Battery" in this section for further testing. The electrical system should be checked for excessive draws.

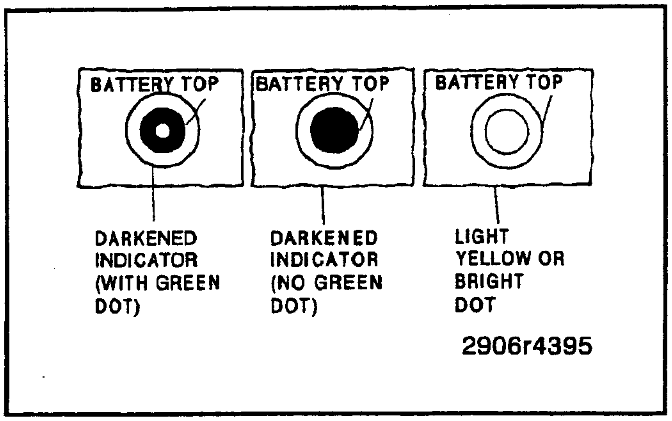

BATTERY TOP
BATTERY TOP
BATTERY TOP
DARKENED INDICATOR (WITH GREEN DOT)
DARKENED INDICATOR (NO GREEN DOT)
LIGHT YELLOW OR BRIGHT DOT
2906r4395

Figure 4—Built-In Hydrometer

3. CLEAR OR LIGHT YELLOW DOT
   - This means the fluid level is below the bottom of the hydrometer and is too low for diagnosis. This may have been caused by excessive or prolonged charging, a broken case, or excessive tipping. When finding a battery in this condition it may indicate high charging voltages caused by a faulty charging system. Therefore, the electrical systems must be checked. The battery should be replaced if the battery has a yellow or clear hydrometer.

DIAGNOSIS OF THE BATTERY

BATTERY TESTING

(Figures 3 through 6)

Tools Required:
Battery Terminal Adapters GM P/N 12303040 or equivalent
J 39200 Digital Multimeter

Use the following procedure for testing batteries:

1. VISUAL INSPECTION
   - Check for obvious damage, such as a cracked or broken case or cover, that could permit loss of electrolyte. If obvious damage is noted, replace the battery. Determine the cause of the damage and correct as needed. If not, proceed to Step 2.
2. HYDROMETER CHECK (Figure 4)
   A. GREEN DOT VISIBLE - Go to Step 3
   B. DARK; GREEN DOT NOT VISIBLE
      - Charge the battery as outlined under "Battery Charging," then proceed to Step 3.
   C. CLEAR OR YELLOW
      - If the hydrometer is clear or light yellow, the battery is low on electrolyte. Replace the battery.
3. LOAD TEST
   - Load testing requires the use of battery side terminal adapters (Figure 5) GM P/N 12303040 or equivalent to ensure good connections. Do not load test a frozen battery. Replace it.

   A. Use J 39200 to measure voltage across the terminals. With all loads off, and the green dot showing in the hydrometer (Step 2), voltage should be 12 volts or higher. Unless the battery has just been discharged (such as by load test or cranking the engine), replace the battery if voltage is below 12 volts.
   B. With J 39200 still attached, connect a battery load tester across the battery terminals.
   C. If the battery has been charging, apply a 300 ampere load for 15 seconds to remove the surface charge from the battery. Remove the load. (Do not complete this step if the battery has not been recently charged.)
   D. Wait 15 seconds to let the battery recover. Apply specified load shown on the battery label or listed in "Specifications" in this section. Read the voltage after 15 seconds, then remove the load.
   E. If the voltage does not drop below the minimum value listed in Figure 6, the battery is good and should be returned to service. (The battery temperature must be estimated by feel and by the temperature the battery has been exposed to for the proceeding few hours.)
   F. If the voltage drops below the minimum listed, replace the battery.

BATTERY ELECTRICAL DRAIN

If the vehicle exhibits a low or dead battery after an overnight period, or discharges over a period of 2 or 3 days, the electrical system should be checked for an excessive electrical drain. This is referred to as parasitic current drain.

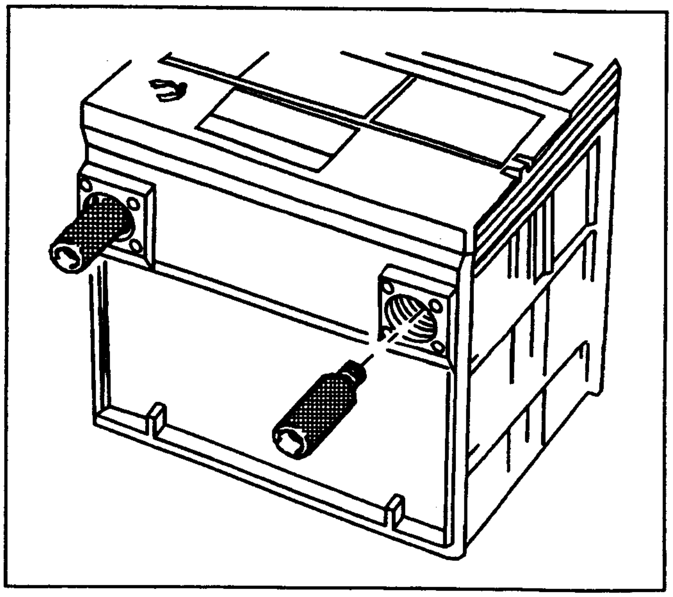


Figure 5—Battery Side Terminal Adapters

ESTIMATED TEMPERATURE	MINIMUM VOLTAGE
70° F. (21° C.)	9.6
50° F. (10° C.)	9.4
30° F. (0° C.)	9.1
15° F. (−10° C.)	8.8
0° F. (−18° C.)	8.5
0° F. (BELOW −18° C.)	8.0

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Figure 6—Battery Temperature vs. Voltage Drop

One or more on-board solid state control modules, such as the Drive Motor Control Module (DMCM), may, at some time, exhibit a failure mode that causes a high parasitic drain on the vehicle's battery. When the battery is disconnected to install an ammeter, etc., the excessive current drain may not occur once circuit continuity is restored. Even though cycling the ignition key to the RUN and then to the OFF position may at times cause such a drain to recur, there may be drains that will not recur unless the vehicle systems are reactivated in a road test. Since the ignition switch must not be rotated tothe ACCESSORY, or RUN, position with an ammeter installed between the battery terminal and the battery cable, a current drain test tool must be used as described in the following procedures.

Before starting this procedure, make sure the ignition switch is in the LOCK position, all electrical accessories are turned off, and the doors closed.

Current Drain Test

Tools Required:

Terminal Adapters GM P/N 12303040 or equivalent.

J 38758 Parasitic Draw Test Switch

J 39200 Digital Multimeter

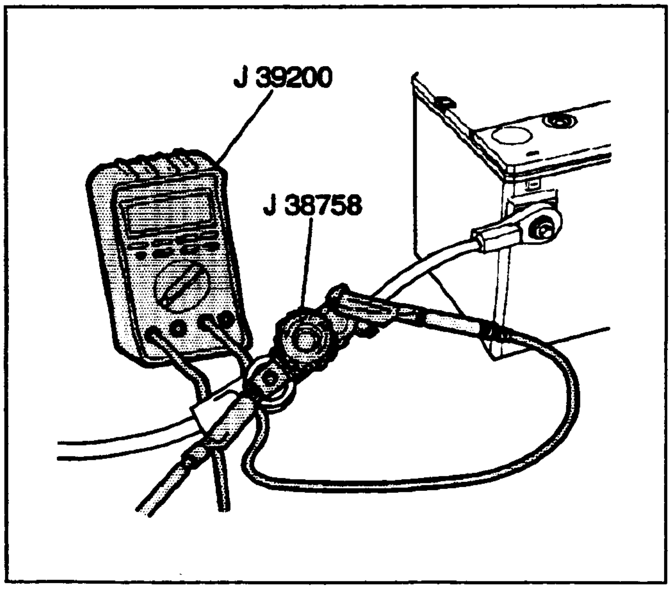


Figure 7—Parasitic Draw Test Switch Installed

NOTICE: ***The parasitic draw test switch should never be turned to the OFF position with the system powered up or damage could occur to the vehicle electrical system.***

1. Remove the negative battery cable at the battery.
2. Install the male end of J 38758 to the negative battery terminal (Figure 7).
3. Turn the knob on the test switch to the OFF position.
4. Install the negative battery cable to the female end of the test switch.
5. Turn the test switch to the ON position.
6. Road test the vehicle while activating all accessories, such as the radio and air conditioning.
7. Turn the ignition switch to the OFF position and remove the key.

Important

- From this point on, electrical continuity must be maintained in the ground circuit to the battery, either through J 38758 (in the ON position) or through the ammeter.

8. Some components, such as the DMCM, have timers that draw several amperes of current while they cycle down. This can give a false parasitic drain reading. Wait 15 minutes for these components to power down before continuing this test.

Important

- Before performing Step 9, if a multimeter is being used other than J 39200, make sure the vehicle does not have a high current drain that might damage the multimeter when it is installed. This can be done using the following procedure:
  A. Connect a jumper wire with an in-line 10A fuse to the terminals on the drain test switch.
  B. Turn the test switch to the OFF position.
  C. Wait about 10 seconds. If the fuse does not blow, current draw is less than 10 amperes, and the multimeter can be used safely.
  D. Before removing the fused jumper wire and installing the multimeter, turn the test switch to the ON position.

9. Set J 39200 to the 10-ampere scale and connect it to the terminals on the test switch.
10. Turn the test switch to the OFF position to allow current to flow through J 39200.
11. Wait at least 60 seconds. Check the current reading. If the current reading is at or below 2 amperes, turn the test switch to the ON position (to maintain continuity in the electrical system) and switch down to the 2 ampere scale for a more accurate reading when the test switch is reopened.
12. Take the reading in milliamps.
13. Find the reserve capacity of the battery in "Specifications" in this section. Divide this number by 4. Compare this to the J 39200 reading. The current drain reading should not exceed this number. (Example: If a battery has a reserve capacity of 100 minutes, the current drain should not exceed 25 milliamps).

NOTICE: ***Always turn the test switch knob to the ON position before removing each fuse to maintain continuity in the electrical system and to avoid damaging J 39200 due to accidental overloading, such as opening a door to change a fuse.***

14. If current draw is too high, remove system fuses one at a time until the draw returns to a value less than or equal to the specifications. Start with fuses that are hot at all times. To remove the fuse, you must first open the door. This may cause a high enough current draw to damage the multimeter. To protect the meter without disrupting electrical continuity, turn the test tool to the ON position before opening the door. Then remove the courtesy lamp fuse. Note the meter reading. If the parasitic load is still excessive, start removing the other fuses, one at a time. Leave the courtesy lamp fuse out during diagnosis so the vehicle door can be left open.

    Perform Steps 10 through 12 each time a fuse is removed.
15. Removing the PCM fuse number 8 should cause a drop of less than 10 milliamps.
    - If the drop is more than 10 milliamps, check the orange wires for a short to ground. Also check the components connected to the orange wires. Refer to the Drive Motor Controls and Battery Pack Controls and Electrical Diagnosis Manual.
    - If there is no drop in the milliamp reading, the DMCM is not drawing current. Refer to the Drive Motor Controls and Electrical Diagnosis Manual.
16. Repeat the parasitic current drain procedure after any repair has been completed.
17. When the cause of excessive current draw has been located and repaired, remove the meter, test switch, and terminal adapters and connect the negative battery cable to the negative battery terminal.

Tighten

- Negative battery cable bolt to 15 N.m (11 ft lb).

ON-VEHICLE SERVICE

BATTERY CHARGING

(Figures 3 and 6)

When it is necessary to charge the battery, follow these basic rules. (Figures 3 and 6):

1. Use a charger with an end charge voltage of 16.0 volts and equipped with a voltmeter that is accurate within 1 percent.
2. Ambient (surrounding) temperature should be 15°C to 38°C (60°F to 100°F). A battery that is extremely cold may not accept measurable current for several hours after starting the charger.
3. The charging area should be well ventilated.
4. Do not charge the battery if the built-in hydrometer is clear or light yellow.
5. Do not charge a battery if it seems to be frozen.
6. Batteries with a green dot showing in the hydrometer do not require charging unless they have just been discharged.

Charging Procedure

CAUTION: Always turn the key to the OFF position when connecting or disconnecting battery cables, battery chargers, or jumper cables. Failure to do so may result in personal injury and damage to the Drive Motor Control Module (DMCM), Body Control Interface Module (BCIM) or other electronic components.

When charging the battery in the vehicle, proceed to Step 1. If charging side terminal batteries out of the vehicle, install adapter kit GM P/N 12303040 or equivalent (Figure 5).

The adapters should be tightened against the lead terminals of the battery to keep resistance between the adapter and the battery terminals to a minimum.

1. Make sure all charger connections are clean and tight.
2. Charge the battery using the charger setting for 12-volt batteries that gives the highest charge rate to the battery until the green dot appears. (Do not use charger settings for jump-starting vehicles to charge the battery. Refer to the charger manufacturer instructions). The battery should be checked periodically while charging. Tap the hydrometer lightly on the top to dislodge any air bubbles that may prevent a correct indication.
3. If the battery feels hot 52°C (125°F), or if violent gassing or spewing of electrolyte through the vent holes occurs, discontinue charging or reduce the charging rate.
4. After charging, the battery should be tested as outlined in "Diagnosis of the Battery" in this section.

Charging Time Required

The time required to charge a battery will vary depending upon the following factors:

- **Size of Battery** - A completely discharged heavy-duty battery requires more than twice the recharging time as a completely discharged light-duty battery.
- **Temperature** - The colder the battery, the more time it takes to recharge. When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. In time the battery will accept a higher rate as the battery warms.
- **Charger Capacity** - The higher the charger amperage, the less time it will take to charge the battery.

- **State-Of-Charge** - A completely discharged battery requires more than twice as much charge as a one-half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, charging current will also increase.

Any battery discharged by parasitic loading, and then allowed to stand in this condition for a period of time, may not accept a charge readily. However, if recharged long enough, many batteries will return to a usable condition.

If the battery remains in an extremely discharged condition for a prolonged period, it can become permanently damaged. This damage can be accelerated by changes in temperatures. Batteries that are extremely discharged can freeze at temperatures as high as -7°C (20°F) and be permanently damaged.

To prevent battery damage and recharge problems, vehicles that are not going to be in service within a 30-day period should have the negative battery cable disconnected to remove the constant drain on the battery. If this is not possible, recharge the battery periodically every 30 to 45 days until the green dot is visible.

CHARGING A LOW OR COMPLETELY DISCHARGED BATTERY

The following procedure should be used to recharge a very low or completely discharged battery. Unless the procedure is properly followed, a perfectly good battery may be needlessly replaced.

1. Measure voltage at the battery terminals with J 39200. If below 11 volts, charge current will be very low and it could take some time before it accepts current in excess of a few milliamperes. Such low current may not be detectable on ammeters other than J 39200.
2. Set the battery charger on the high setting.
3. Some chargers feature polarity protection circuitry that prevents charging unless the charger leads are connected to the battery terminals correctly. A completely discharged battery may not have enough voltage to activate this circuitry even though leads are connected properly, making it appear that the battery will not accept charging current. Therefore, follow the charger manufacturer's instructions telling how to bypass or override the circuitry so the charger will turn on and charge a low-voltage battery.
4. Battery chargers vary in the amount of voltage and current they provide. The time required for the battery to accept measurable charger current at various voltages may be as follows:
    - 16.0 volts or more up to 4 hours
    - 14.0 to 15.9 volts up to 8 hours
    - 13.9 volts or less up to 16 hours

    Important

    - If the charge current is not measurable at the end of the above charging times, the battery should be replaced.
    - If the charge current is measurable during the charging time, the battery is considered good. Complete charging in the normal manner.
5. It is critical to remember that a completely discharged battery must be recharged for a sufficient number of Ampere Hours (AH) to restore it to a useable state. As a rule of thumb, use the reserve capacity rating of the battery to determine how long it will take to completely recharge the battery. For capacity ratings, refer to Specifications. Divide the reserve capacity rating by the amount of ampere charge to determine how many hours of charging are needed. (Rating divided by amperes = hours.)
    - For example: a battery with a reserve capacity rating of 75, charged at a rate of 10 amperes, will take 7.5 hours to fully recharge (75 divided by 10 = 7.5). The same battery, charged at a rate of 25 amperes, will take 3 hours to fully recharge (75 divided by 25 = 3).
6. Any battery recharged by this procedure should be load tested to determine serviceability. Refer to Diagnosis of the Battery in this Section.

JUMP STARTING IN CASE OF EMERGENCY

The booster battery and the discharged battery should be treated carefully when using jumper cables. Follow the procedure outlined below, being careful not to cause sparks.

CAUTION: Batteries produce explosive gasses, contain corrosive acid, and supply levels of electrical current high enough to cause burns. Therefore, to reduce the risk of personal injury when working near a battery:

- **Always shield your eyes and avoid leaning over the battery whenever possible.**
- **Do not expose the battery to open flames or sparks.**
- **Do not allow battery acid to contact the eyes or skin. Flush any contacted areas with water immediately and thoroughly, and get medical help.**
- **Follow each step in the jump starting instructions.**

NOTICE: *Do not push or tow the vehicle. Under some conditions this may damage parts of the vehicle. Also, since this vehicle has a 12-volt negative ground electrical system, make sure the vehicle or equipment used to jump start the vehicle is also12-volt negative ground. Use of any other type system may damage the vehicle's electrical components.*

Jump Starting Procedure

1. Position the vehicle with the good (charged) battery so the jumper cables will reach, but NEVER let the vehicles touch. Also, make sure the jumper cables do not have loose or missing insulation.
2. Set the parking brake and place the shift selector lever in PARK. Turn off the ignition, lights, and all other electrical loads that aren't needed. Leave the hazard flashers ON.

3. Check the built-in hydrometer. If it is clear or light yellow, do not charge the battery.
4. Attach the end of one jumper cable to the positive terminal of the booster battery and the other end of the same cable to the positive terminal of the red jump start block of the dead vehicle (Figure 8). In Figure 8, A is the good battery, B isthe dead battery.
5. Attach one end of the remaining negative jumper cable to the negative terminal of the booster battery.
6. Make the final connection of the negative cable to a solid engine ground (such as the A/C compressor bracket or the frame mounting brackets), at least 450 millimeters (18 inches) from the battery of the vehicle being started (Figure 8).
7. Start the engine of the vehicle that is providing the jump start and turn off all electrical accessories. Then turn the ignition switch to the RUN position in the vehicle with the discharged battery.
8. Reverse these directions exactly when removing the jumper cables. The negative cable must be disconnected from the engine that was jump started first. In Figure 9, A is the good battery, B is the dead battery.

BATTERY REPLACEMENT

Remove or Disconnect (Figures 3 and 10)

1. Negative cable from the negative battery terminal.
2. Positive cable from the positive battery terminal.
3. Battery retainer and nut.
4. Battery.

Inspect

1. Battery for damage.
2. Cables and connectors for wear or corrosion.
3. Carrier for damage or foreign objects.
   - If damage is noted, find and correct the cause.

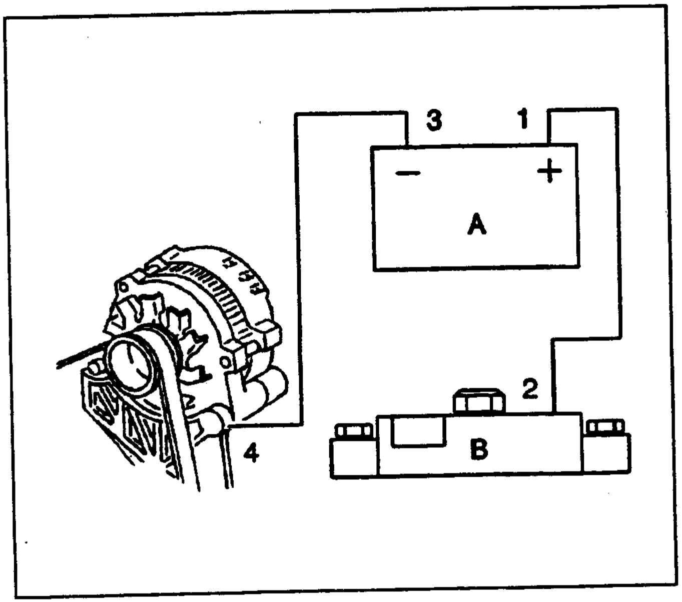


Figure 8—Installing Jumper Cables

Install or Connect (Figures 3 and 10)

1. Battery into cleaned carrier.
2. Retainer and nut.

Tighten

- Retainer nut to 17 N.m (13 lb ft).

3. Positive cable to the positive terminal.
4. Negative cable to the negative terminal.

Tighten

- Battery terminals to 15 N.m (11 lb ft).

BATTERY CABLE REPLACEMENT AND ROUTING

Whenever the auxiliary battery cables are replaced, always use a replacement cable that is the same type, diameter, and length. Some positive cables have additional feed wires attached to them andsome negative cables have additional ground leads attached.

Always be certain when replacing a battery cable to route it the same as the original cable.

Negative Battery Cable

Remove or Disconnect (Figure 12)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Remove the cable from the battery.
3. Remove the cable and mounting screw from the radiator support and wiring harness ground lead.

Install or Connect (Figure 12)

1. Install cable and electrical harness ground lead to radiator support.
2. Install the cable to the battery.
3. Install the high-voltage disconnect. Refer to Battery Pack Controls.

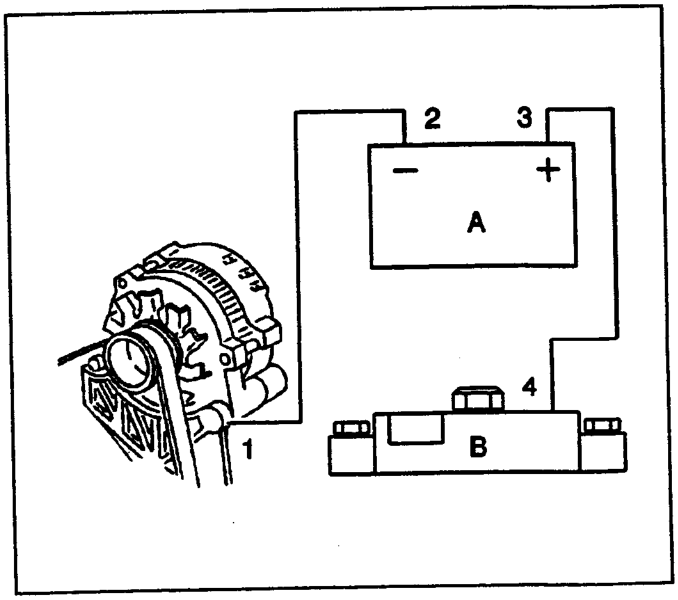


Figure 9—Removing Jumper Cables

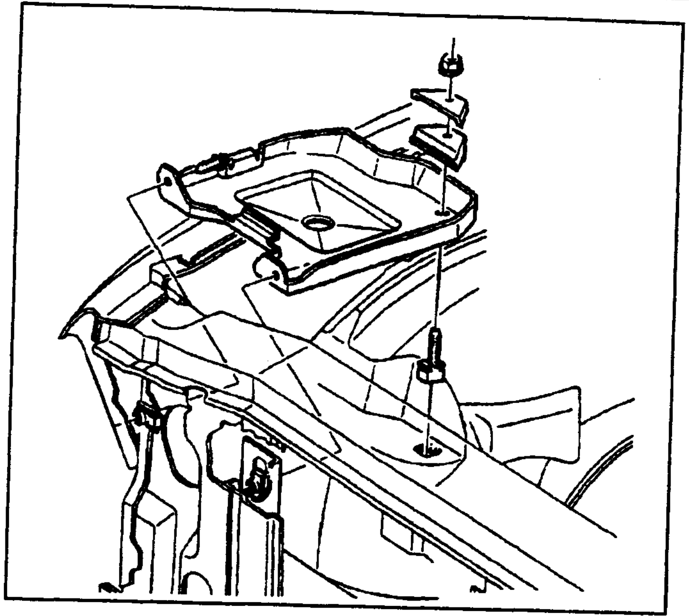


Figure 10—Battery and Tray Installation

Positive Battery Cable

Remove or Disconnect (Figure 12)

1. Remove the high-voltage disconnect. Refer to Battery Pack Controls.
2. Remove the cable from the battery.
3. Remove the cable clips from the PIM frame.
4. Remove the cable from the rear of the PIM.
5. Remove the plastic cable cover located over the brake booster.
6. Remove the cable from the terminal block located on the left fender.
7. Remove the cable.

Install or Connect (Figure 12)

1. Install the cable leads to the terminal block located on the left fender.
2. Route the cable over the top of the brake booster.
3. Install the plastic cable cover.
4. Install the cable to the rear of the PIM.
5. Install the cable clips into the PIM frame.
6. Install the cable to the battery.
7. Install the high-voltage disconnect. Refer to Battery Pack Controls.

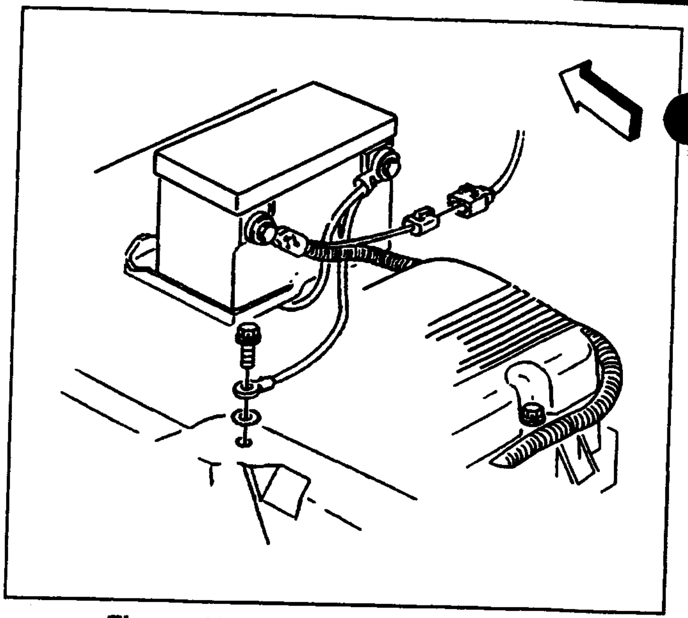


Figure 11—Auxiliary Battery Cables

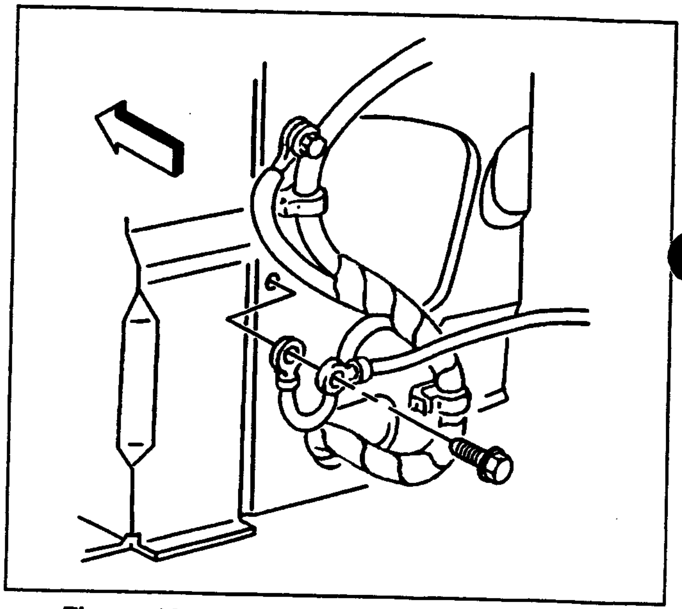


Figure 12—Negative Battery Cable Ground

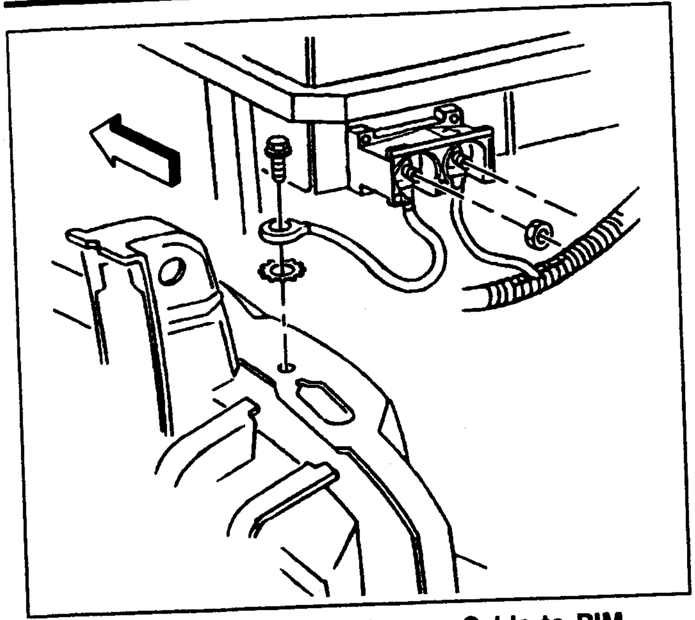


Figure 13—Positive Battery Cable to PIM

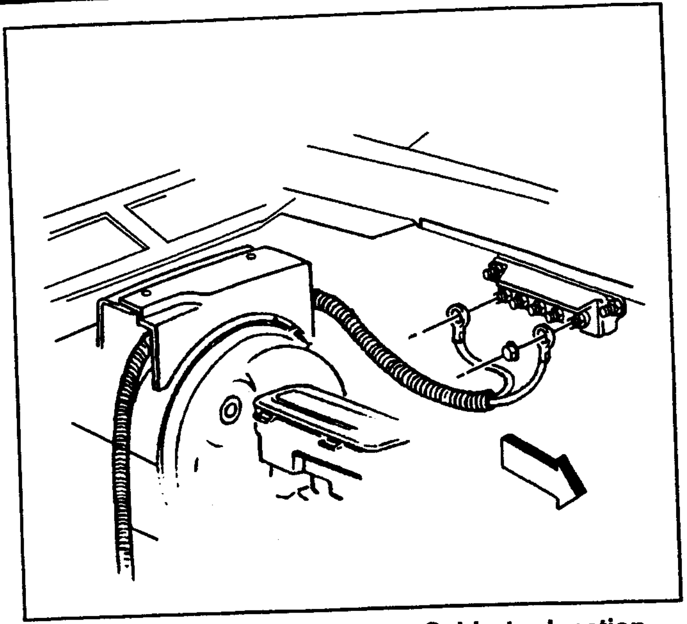


Figure 14—Positive Battery Cable to Junction Block

GROUND STRAPS

Additional ground straps are used to connect the body and frame to the Drive Motor Control Module (DMCM) and drive motor always connect all ground straps to ensure a good ground path to the battery from all electrical components.

SPECIFICATIONS

BATTERY SPECIFICATIONS

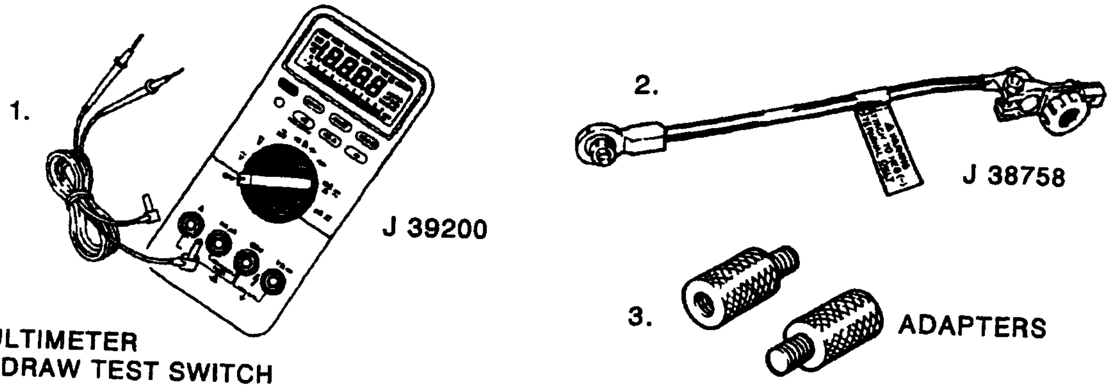
Option	Catalog No.	CCA (Amps)	Res. Cap. (Minutes)	Ld. Tst. (Amps)	Recommended Replacement
Base	514	525	90	260	75-60
UA1	484	690	115	300	78A-72

T3125

FASTENER TIGHTENING SPECIFICATIONS

Application	N.m	Lb Ft	Lb In
Battery Cable Bolt	15	11	—
Battery Retainer Nut	17	13	—
Battery Terminals	15	11	—

SPECIAL TOOLS



1. DIGITAL MULTIMETER
2. PARASITIC DRAW TEST SWITCH
3. BATTERY TERMINAL ADAPTERS
   – GM P/N 12303040

2906r4400

SECTION 6D5

PROPULSION SYSTEM WIRING

HARNESS CARE

When it is necessary to move any of the wiring, whether to lift wires away from their harnesses or move harnesses to reach a component, make sure that all wiring is replaced in its original position and all harnesses are routed correctly. If clips or retainers break, replace them. Electrical problems can result from wiring or harnesses becoming loose and moving from their original positions, or from being rerouted. Refer to Figures 1 through 16 for correct routing of propulsion system wiring.

HARNESS REPLACEMENT

Most wiring harness conditions can be corrected efficiently by replacing a wire or a connector rather than installing a new, complete wiring harness. If propulsion system wiring harness replacement is necessary, use the following suggestions as a guide.

On an original equipment harness, one or more connectors may be taped back to the casing and not used for a specific application. When installing a replacement harness, tape back the corresponding wire(s) and connector(s) and any other unused connectors of the new harness.

For accuracy, work from one end of the harness to the other, removing only a short portion of the harness at a time and installing the corresponding part of the replacement harness before moving on to the next portion.

Always scrape away dirt and corrosion from around the hole for the attaching screw holding a ground wire connector. Use a new screw if the existing one is not clean and corrosion-free.

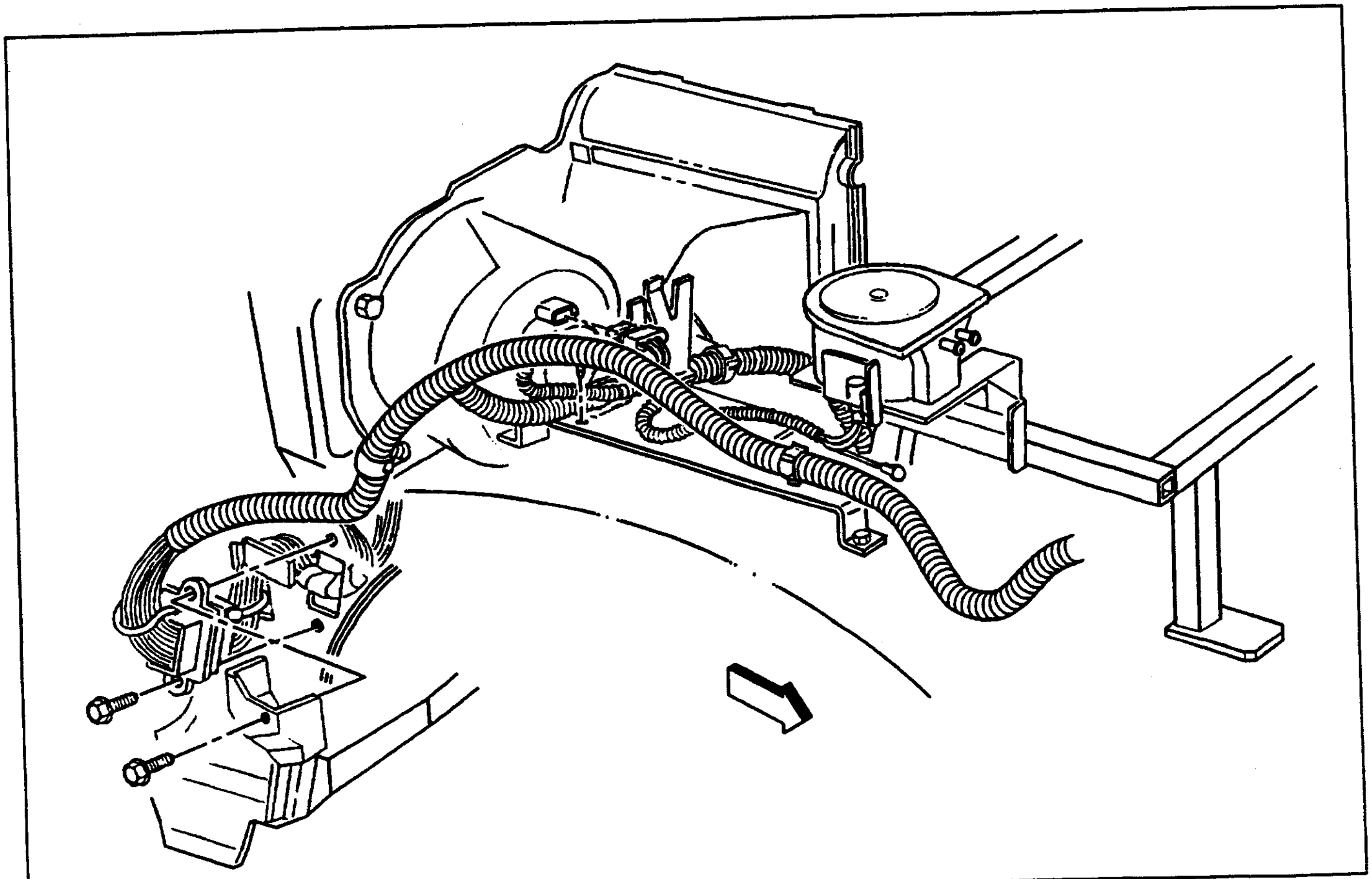


Figure 1—Propulsion System Wiring -Blower Motor

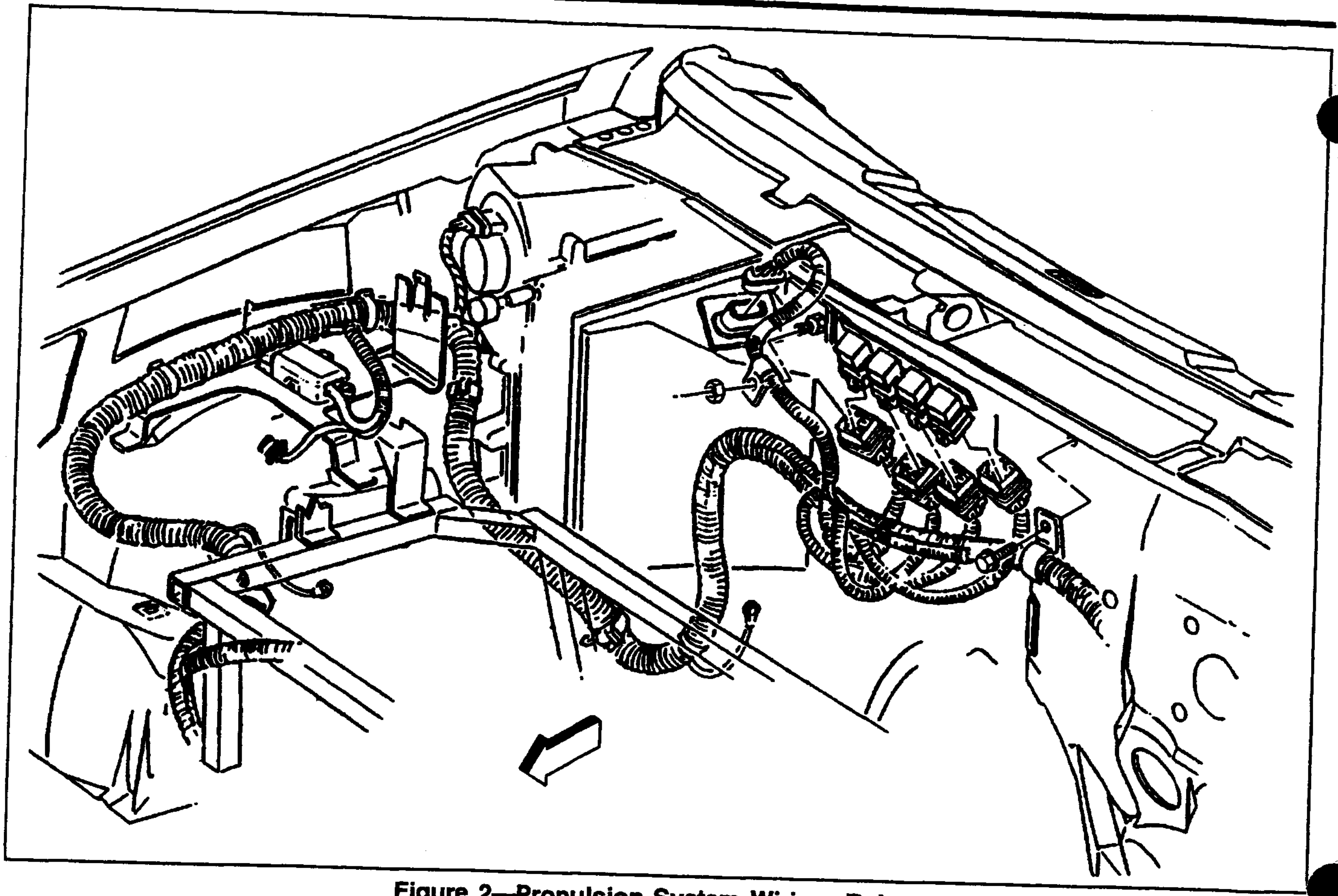


Figure 2—Propulsion System Wiring -Relays

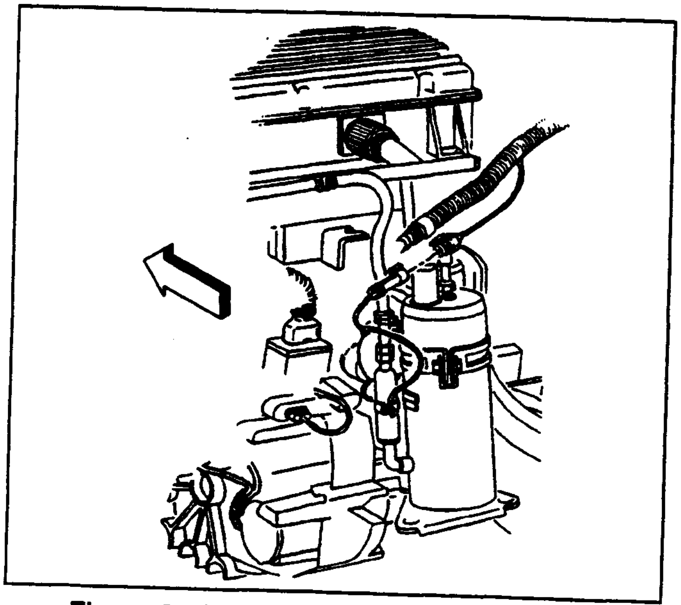


Figure 3—Propulsion System Wiring - Air Conditioning Compressor

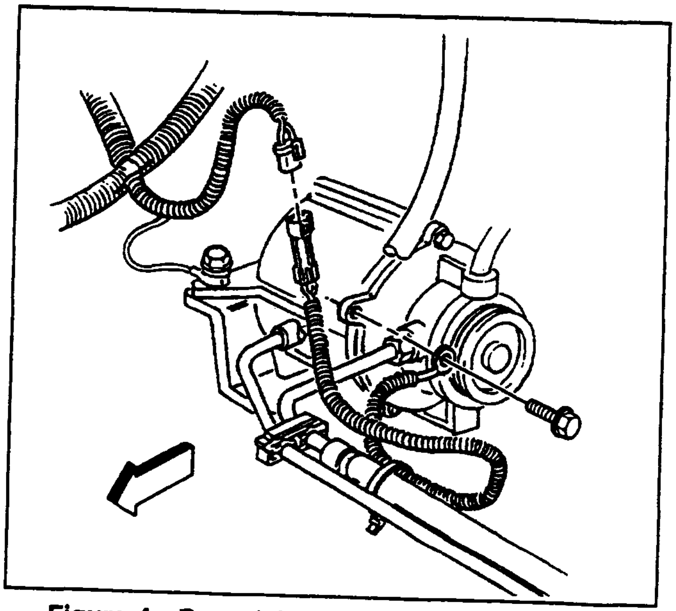


Figure 4—Propulsion System Wiring - Power Steering Pump

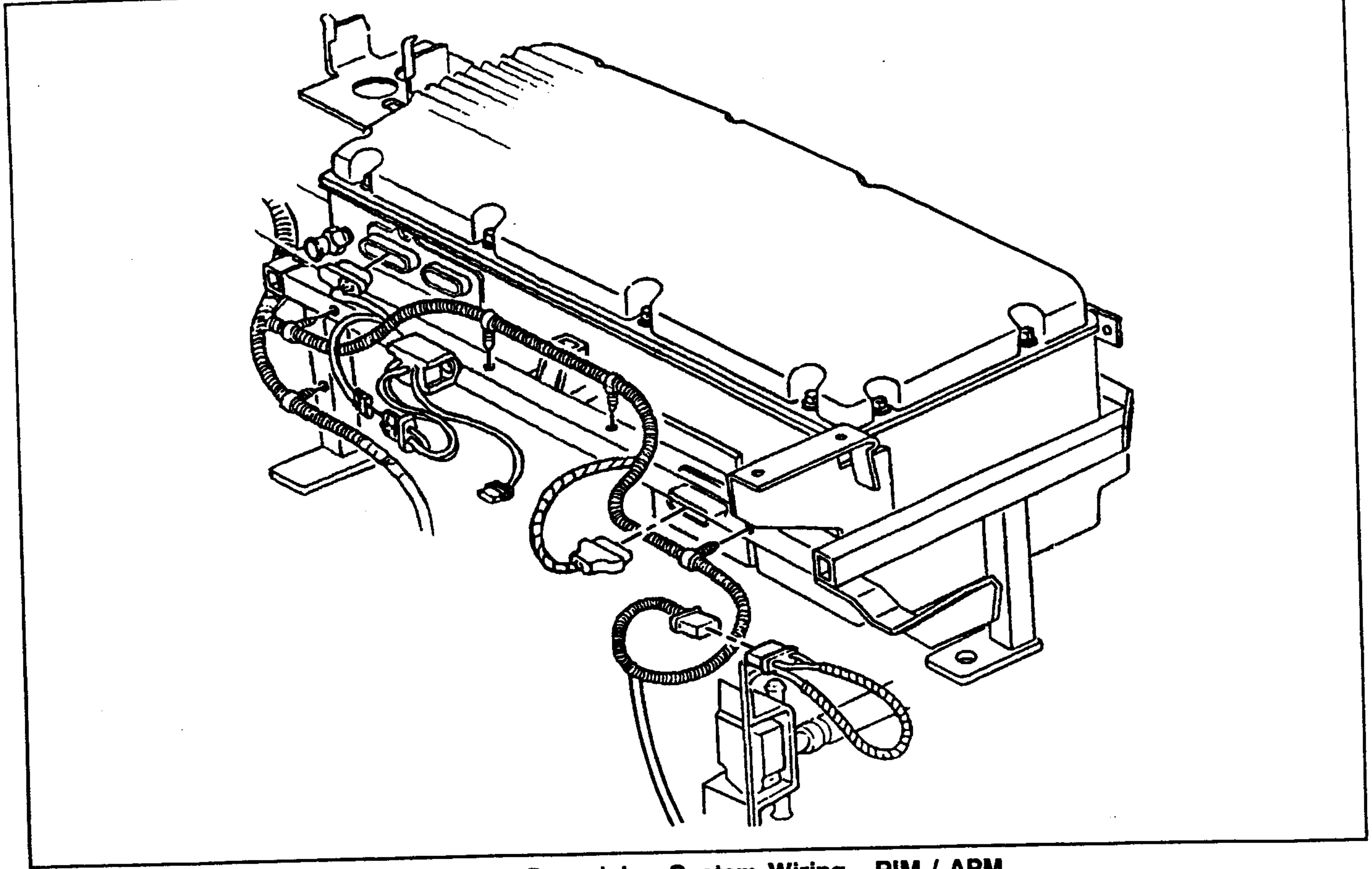


Figure 5—Propulsion System Wiring - PIM / APM

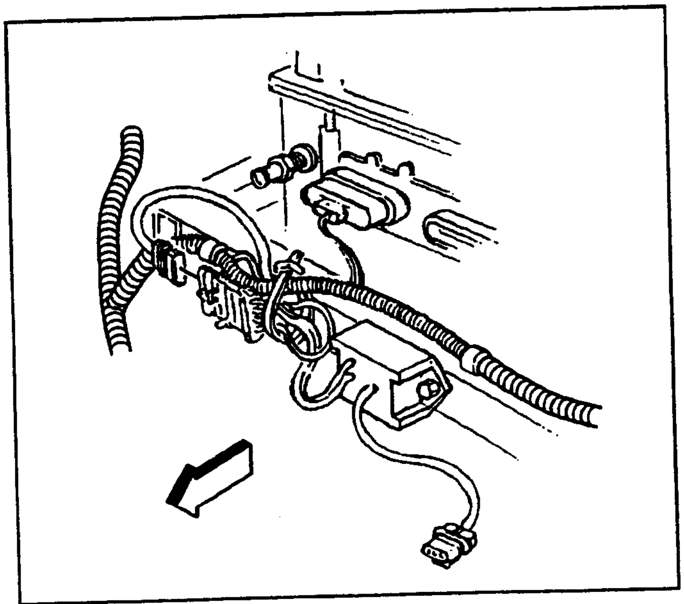


Figure 6—Propulsion System Wiring - Fan Buffer

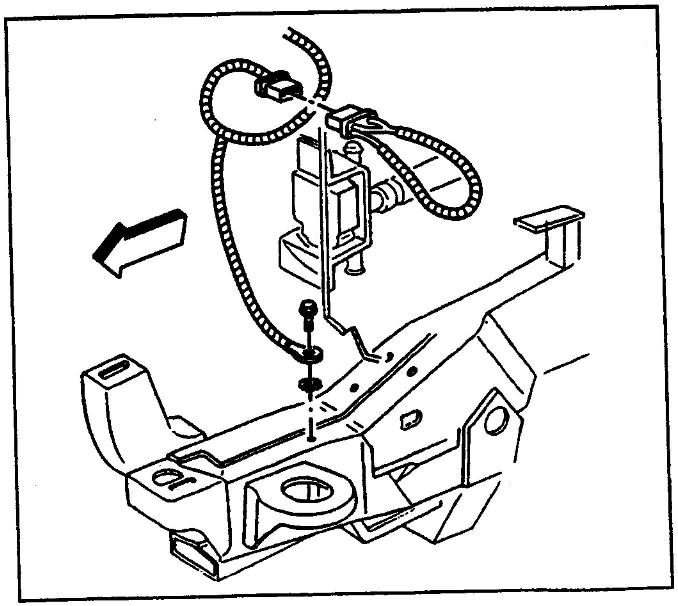


Figure 7—Propulsion System Wiring -Ground to Frame

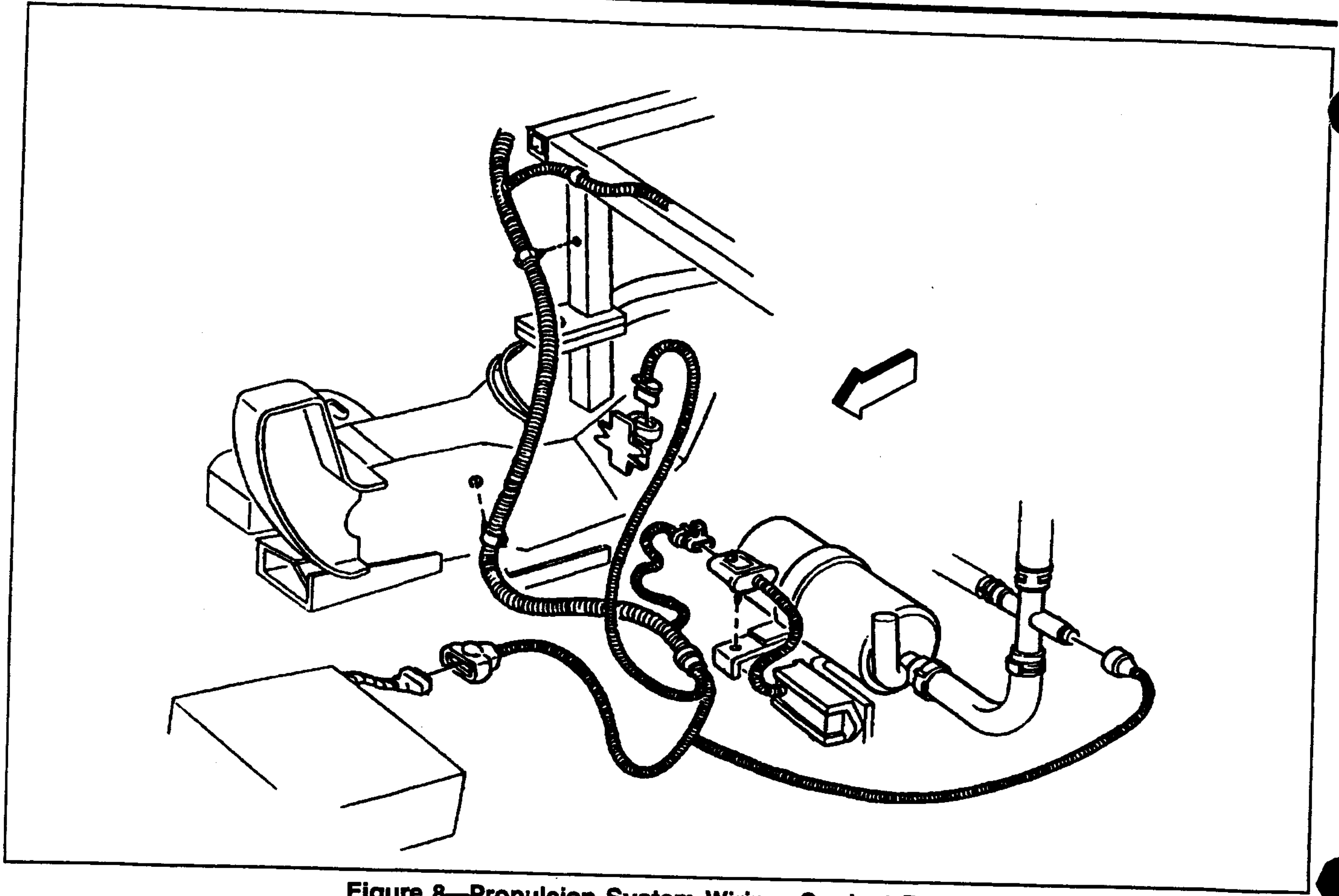


Figure 8—Propulsion System Wiring -Coolant Pump

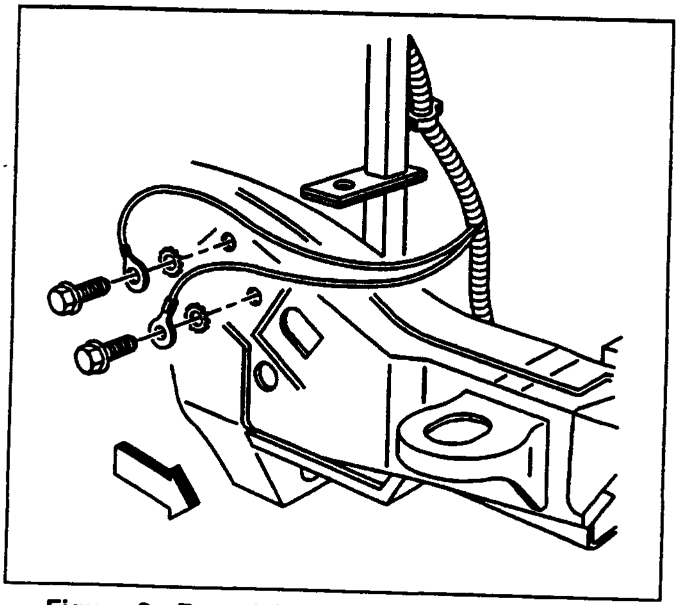


Figure 9—Propulsion System Wiring -Ground

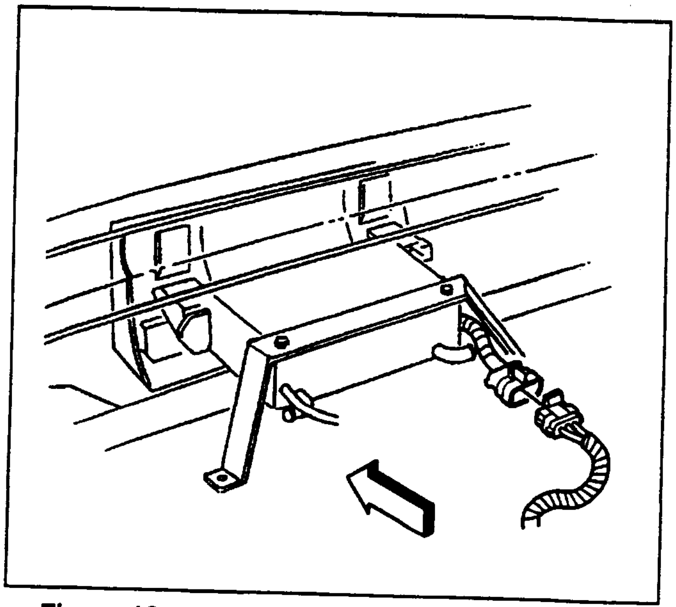


Figure 10—Propulsion System Wiring -Charge Receptacle

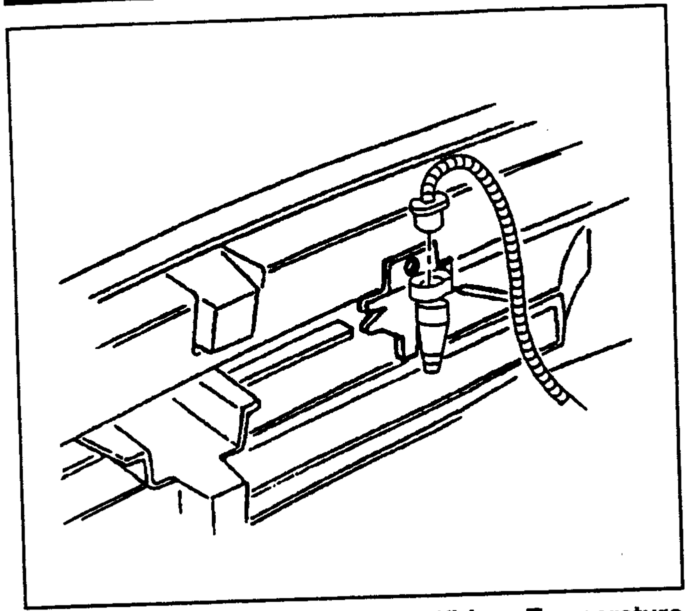


Figure 11—Propulsion System Wiring -Temperature Sensor

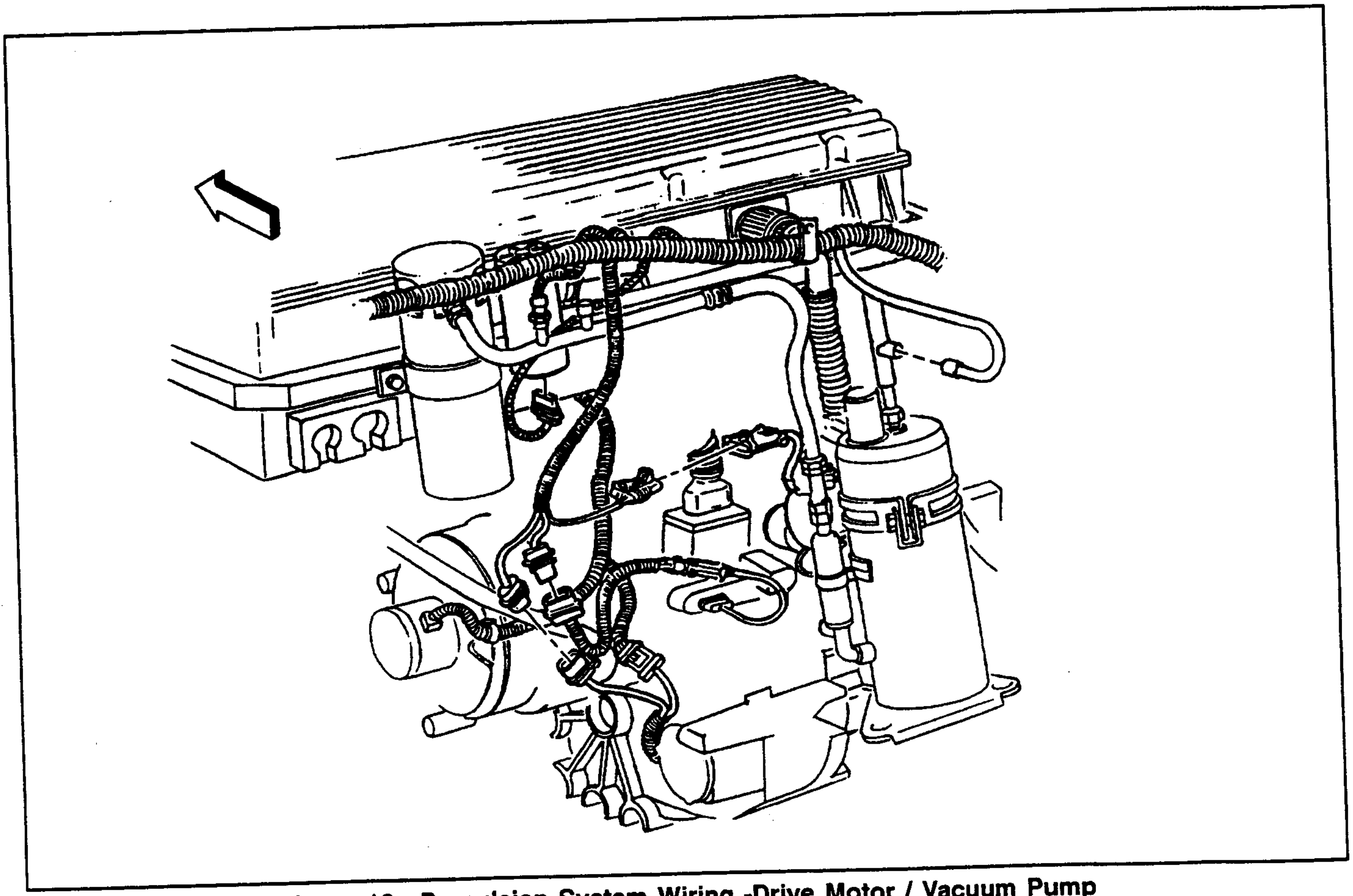


Figure 12—Propulsion System Wiring -Drive Motor / Vacuum Pump

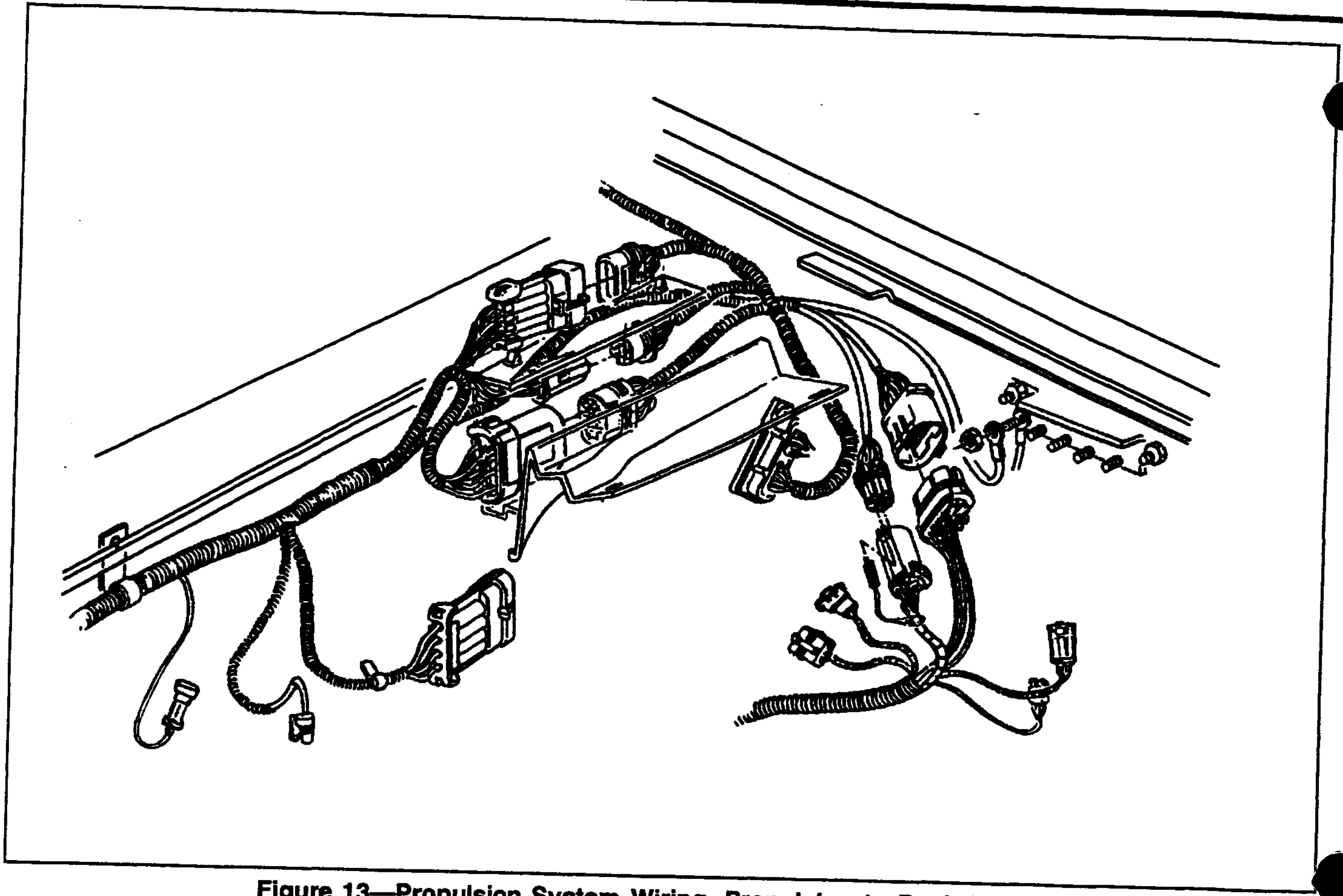


Figure 13—Propulsion System Wiring -Propulsion to Dash Harness

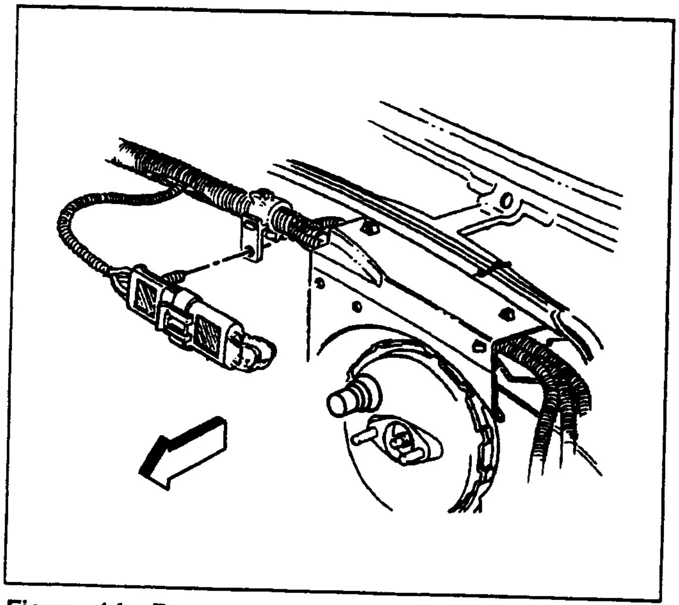


Figure 14—Propulsion System Wiring -High-Voltage Disconnect

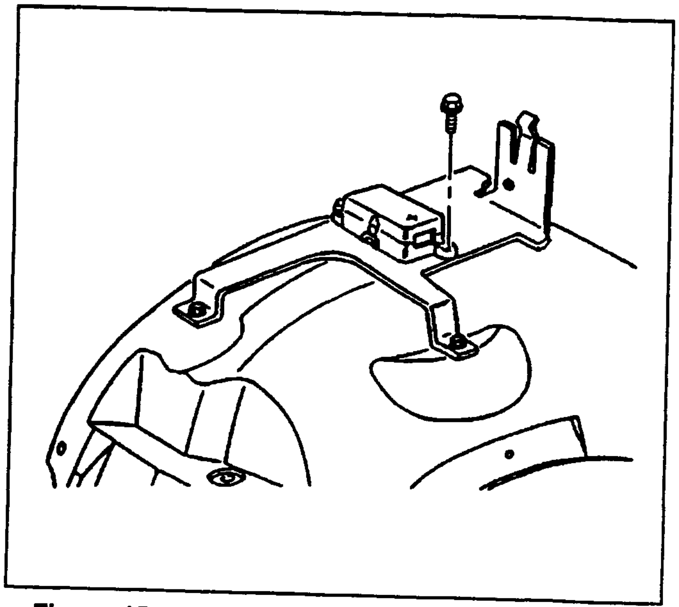


Figure 15—Propulsion System Wiring -Junction Block

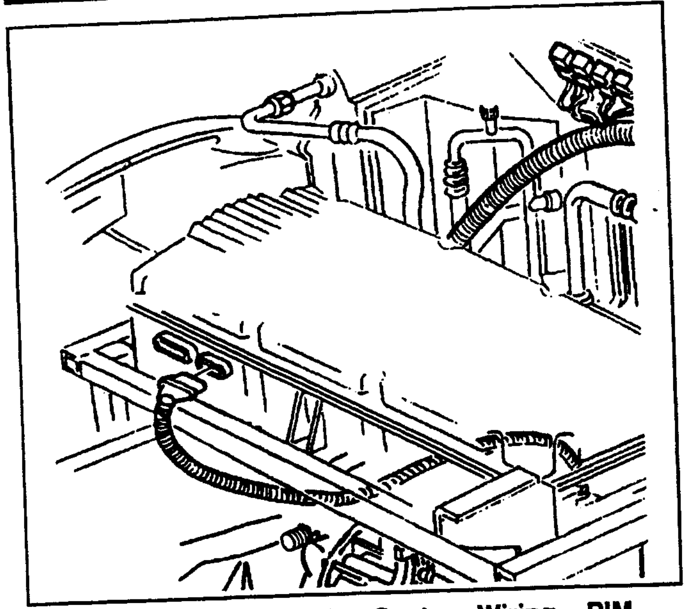


Figure 16—Propulsion System Wiring - PIM

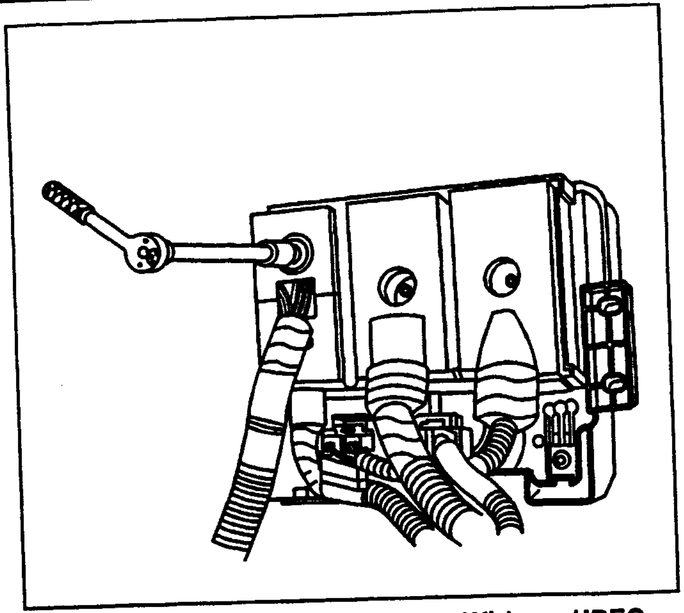


Figure 18 - Propulsion System Wiring - UBEC Connector Removal

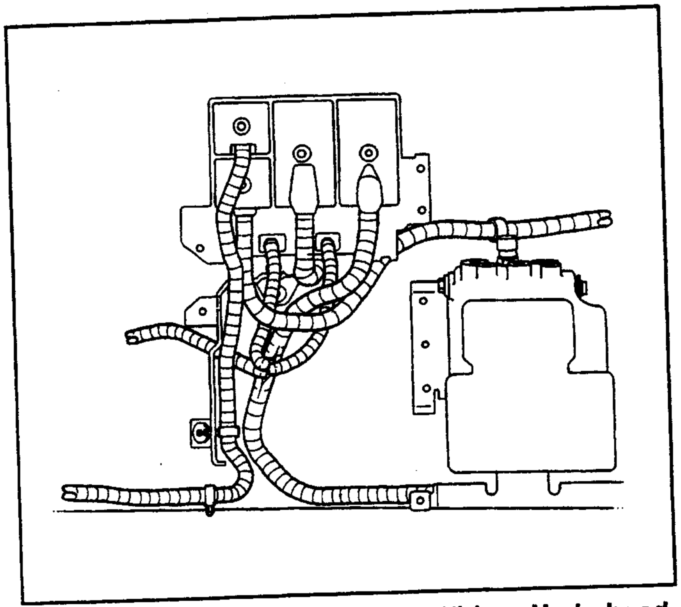


Figure 17 - Propulsion System Wiring -Underhood Bussed Electrical Center (UBEC)

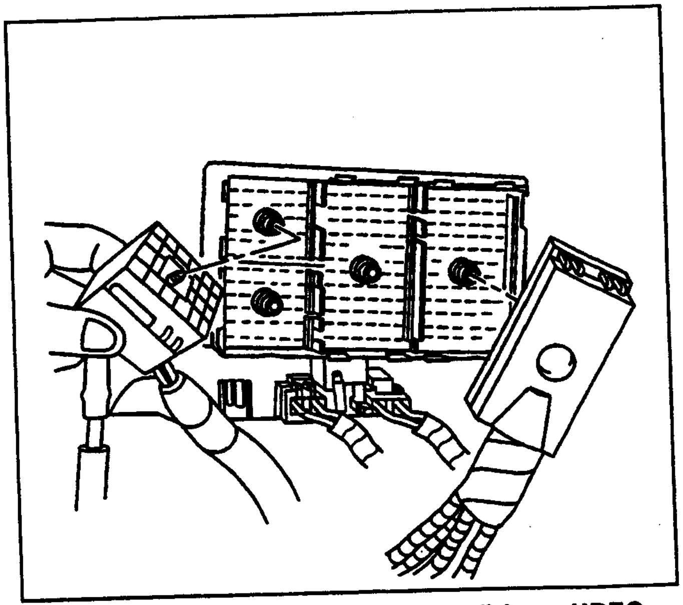


Figure 19 - Propulsion System Wiring - UBEC Connector Installation

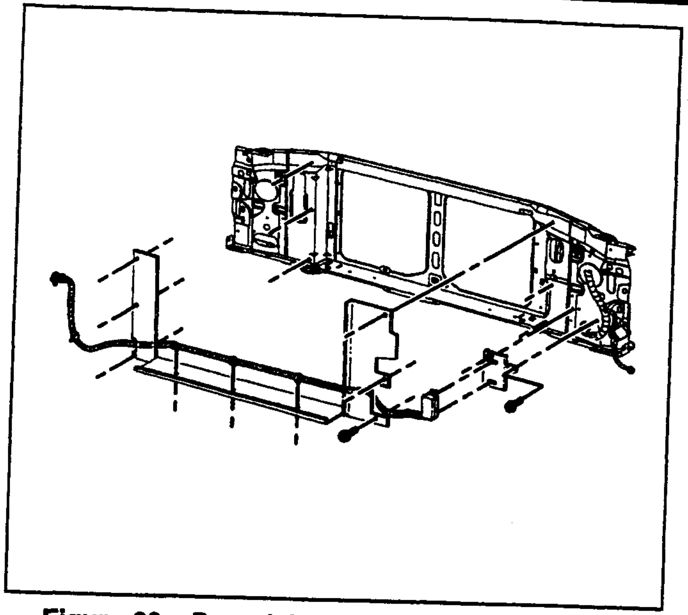


Figure 20 - Propulsion System Wiring - UBEC Battery Cable routing

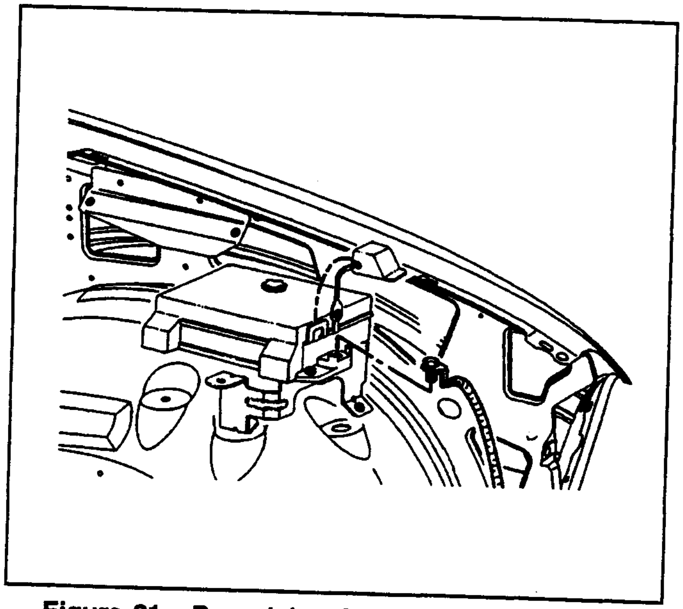


Figure 21 - Propulsion System Wiring - UBEC Battery Cable Connection

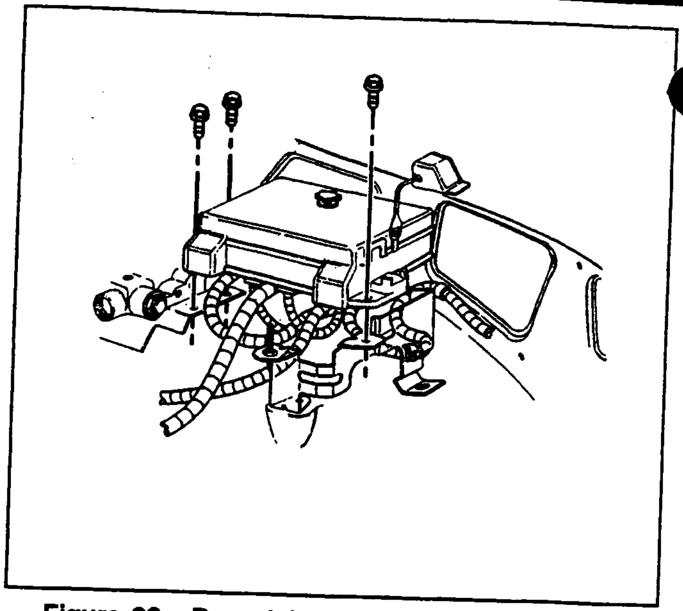


Figure 22 - Propulsion System Wiring - UBEC Installation

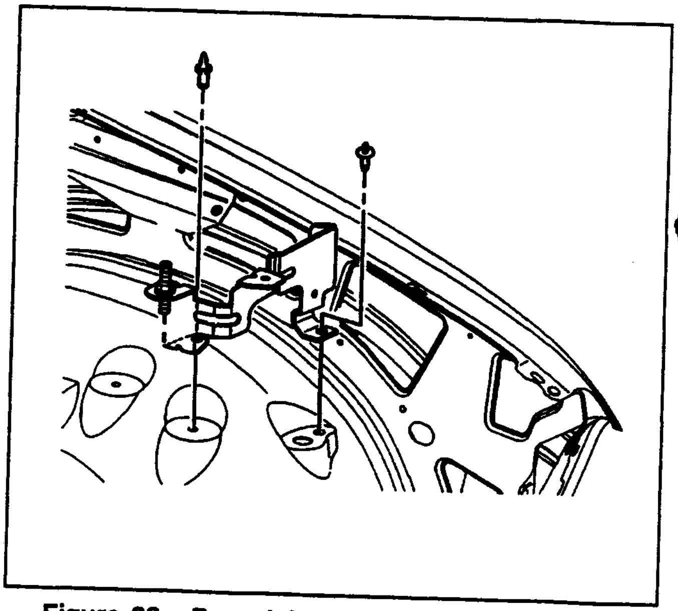


Figure 23 - Propulsion System Wiring - UBEC Mounting Bracket

SECTION 7

Shift Controls

Drive Unit Shift Controls 7A-1
  On-Vehicle Service 7A-1
    Shift Cable Replacement 7A-1
    Shift Cable Adjustment 7A-2
Specifications 7A-2
  Fastener Tightening Specifications 7A-2

BLANK

SECTION 7A

SHIFT CABLE

ON-VEHICLE SERVICE

SHIFT CABLE REPLACEMENT

↔ Remove or Disconnect (Figures 1 through 4)

1. Apply the parking brake.
2. Position the steering column shift lever to the N (neutral) position.
3. Ensure the motor shift lever is positioned to mechanical neutral.
4. Steering column filler panel. Refer to Steering Columns.
5. Retainer securing the shift cable to the steering column bracket (Figure 1).
6. Shift cable end from the steering column shift bracket ball stud.
7. Grommet securing the shift cable to the dash panel (Figure 2).
   - Push the grommet through the dash panel toward the front of the vehicle.
   - Raise and support the vehicle.
8. Strap securing the shift cable to the subframe (Figure 3).
   - Discard strap.
9. Bolt securing the shift cable clip to the frame bracket.
10. Retainer securing the shift cable to the motor bracket (Figure 4).
    - Squeeze the cable retainers while pulling the cable towards the rear of the vehicle.
11. Shift cable end from the motor control lever ball stud.
12. Shift cable from the vehicle.

→← Install or Connect (Figures 1 through 4)

! Important

- Ensure the motor control lever and steering column selector are in their mechanical neutral positions.

1. Lower the vehicle if necessary.
2. Retainer securing the shift cable to the steering column bracket (Figure 1).
3. Shift cable end to the steering column shift bracket ball stud.
4. Grommet securing the shift cable to the dash panel (Figure 2).
5. Steering column filler panel. Refer to Steering Columns.
6. "New" strap securing the shift cable to the sub-frame (Figure 3).
7. Bolt securing the shift cable clip to the frame bracket and nut.

Tighten

- Bolt securing the shift cable clip to the frame bracket to 18 N.m (13 lb ft).

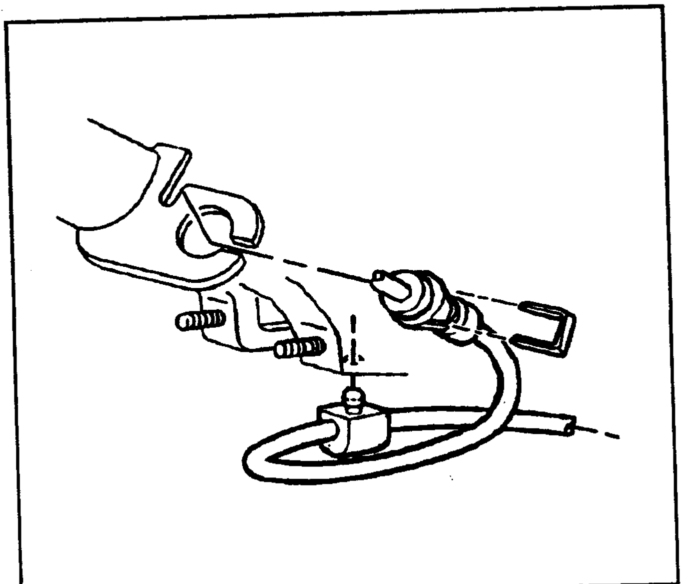


Figure 1—Shift Cable and Steering Column

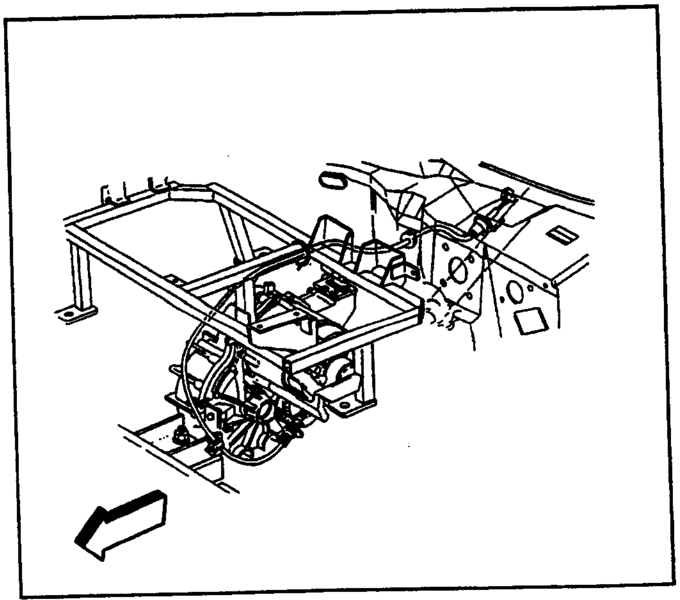


Figure 2—Shift Cable Routing

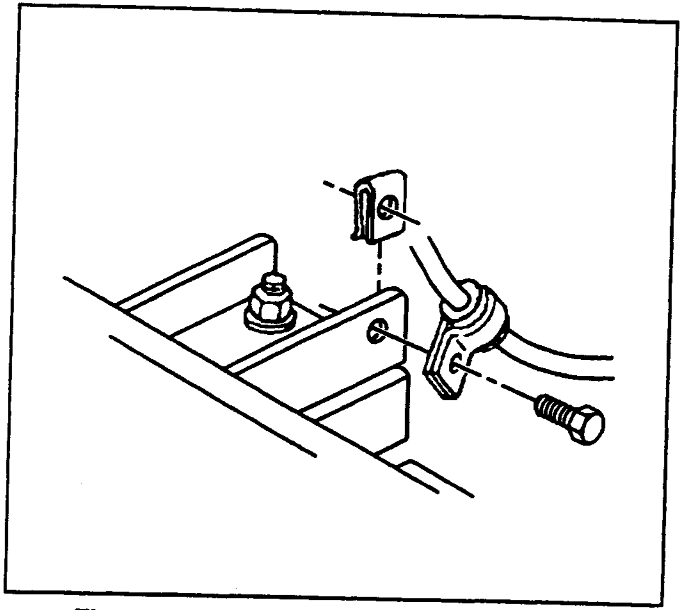


Figure 3—Shift Cable and Frame Bracket

8. Retainer securing the shift cable to the motor bracket (Figure 4).
9. Shift cable end to the motor control lever ball stud.

Important

- If the shift cable end does not align with the motor control lever ball stud, refer to Shift Cable Adjustment in this section.

10. Lower the vehicle.
11. Check for proper shift operation.

SHIFT CABLE ADJUSTMENT

Important

- Ensure the steering column selector is in the N (neutral) position.
- Raise and support the vehicle if necessary.

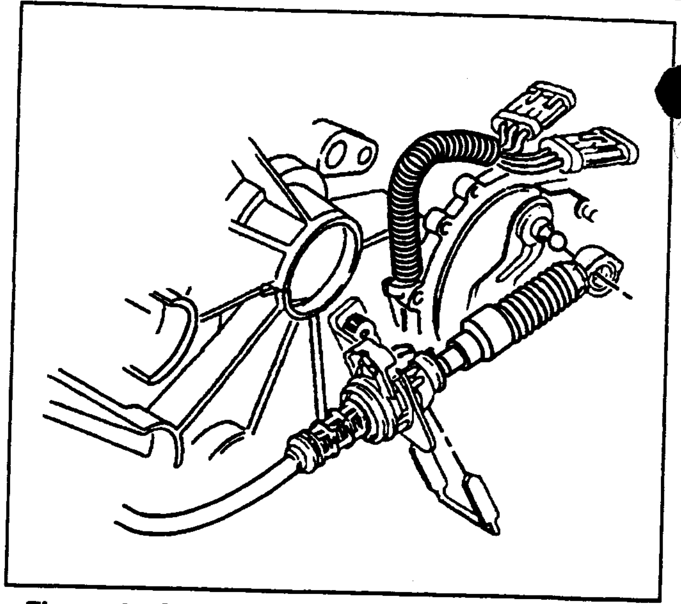


Figure 4—Shift Cable End and Motor Shift Lever

- Ensure the shift cable end is removed from the motor control lever ball stud.
- Ensure the motor control lever is in the mechanical neutral position.

Adjust

1. Position the locking tab, on the motor control lever end of the shift cable, OUT to release the shift cable adjuster (Figure 4).
    - The locking tab is located next to the motor bracket on the opposite side of the retainer.
2. Allowing the shift cable adjuster to move, position the shift cable end to the motor control lever ball stud.
3. Press (push) the locking tab on the shift cable in to lock the shift cable adjuster.
    - Lower the vehicle.
4. Check for proper shift operation.

SPECIFICATIONS

Fastener Tightening Specifications

Application	N·m	Lb ft	Lb in
Shift Cable Clip Bolt	18	13	—

A

- Abbreviations & Acronyms 0A-7
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    - Blower Noise 1B-9, 20
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    - Fuel-Fired Heater Diagnosis 1B-6
    - Function Test 1B-7
    - Heater Function Test 1B-8
    - Heater Output Temperature Check 1B-9
      - Preparation 1B-9
      - Temperature Check 1B-9
    - Improper Air Delivery 1B-9
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    - Refrigerant System Diagnosis 1B-12
      - Refrigerant System Checks 1B-12
        - Compressor Motor Electrical Test # 2 .... 1B-17
        - Compressor Motor Insulation Test # 1 (MEGGAR) 1B-16
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    - Relays and Sensors 1B-9
      - Blower Motor Relay 1B-9
      - Fuel-Fired Heater Relay 1B-9
      - High-Pressure Sensor 1B-9
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      - Electronic Leak Detector 1B-19
      - Evaporator Core 1B-20
      - Service Ports/Access Valves 1B-20
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  - Diagnosis of the Refrigerant Recovery, Recycling and Recharging System 1B-25
    - A/C Odor Diagnosis 1B-26
    - Air Conditioning System Odor Procedure 1B-26
  - General Description 1B-1
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